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AN OCEANOGRAPHIC SURVEY OF THE COSTAL WATERS BETWEEN SAN FRANCISCO BAY AND MONTEREY BAY, CALIFORNIA.

by

Peter Stephen Labyak

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THESIS

AN OCEANOGRAPHIC SURVEY OF THE COASTAL WATERS BETWEEN SAN FRANCISCO BAY AND MONTEREY BAY, CALIFORNIA

by

Peter Stephen Labyak

October 1969

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An Oceanographic Survey of the Coastal Waters Between San Francisco Bay and Monterey Bay, California

by

Peter Stephen Labyak
Lieutenant, United States Navy
B.S., United States Naval Academy, 1962

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OCEANOGRAPHY

from the

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ABSTRACT

A detailed oceanographic survey of the coastal waters between Monterey Bay and San Francisco Bay, California, was conducted from 10 through 18 May 1969. Measurements of beam transmittance, sound velocity, temperature, and particulate count were obtained. Over 500 water samples were taken for particulate analysis.

The optical properties of this region were found to be very complex. The waters appeared to be affected by flow from San Francisco Bay, littoral material, upwelling, and possibly sewage outfalls during the survey. A greater volume of water with low transmissivity and high particle count existed in the northern region of the survey area than in the southern region. An eddy system between Monterey Bay and Point Ano Nuevo was suggested.

Approximately 90 percent of the particles affecting beam transmittance were less than 12 μ in diameter. Particle sizes were found to decrease with increased depths. A fairly good correlation of beam transmittance with particle count was observed except in near shore areas.

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TABLE OF CONTENTS

Page

I. INTRODUCTION ---------- 10

A. PURPOSE ---------- 10

B. BACKGROUND ---------- 11

C. OCEANOGRAPHIC CLIMATOLOGY ---------- 15

D. COASTAL INFLUENCES ---------- 18

II. OBSERVATIONAL PROCEDURES ---------- 21

A. CRUISE PLAN ---------- 21

B. SAMPLING PROCEDURES ---------- 23

III. EQUIPMENT DESCRIPTION ---------- 26

A. BEAM TRANSMISSOMETER ---------- 26

B. SOUND VELOCITY-TEMPERATURE-DEPTH SYSTEM ---------- 26

C. SELF-CONTAINED SALINITY-TEMPERATURE-DEPTH MEASURING SYSTEM ---------- 27

D. BOTTOM WATER SAMPLER ASSEMBLY ---------- 29

E. COULTER COUNTER ---------- 29

F. EXPENDABLE BATHYTHERMOGRAPH SYSTEM ---------- 31

G. MECHANICAL BATHYTHERMOGRAPH ---------- 31

IV. ANALYSIS OF OBSERVATIONS ---------- 32

A. INTRODUCTION ---------- 32

B. AREA DESCRIPTION ---------- 33

1. Horizontal Contours ---------- 33

2. Vertical Contours ---------- 36

a. Perpendicular Cross Sections ---------- 36

b. Parallel Cross Sections ---------- 43

3. Comparison With Past Data ---------- 46

C. CORRELATION OF TEMPERATURE AND BEAM TRANSMITTANCE ---- 47

D. CORRELATION OF TEMPERATURE AND PARTICULATE MATTER ---- 48

E. CORRELATION OF BEAM TRANSMITTANCE AND PARTICULATE MATTER -- 48

F. CORRELATION OF BEAM TRANSMITTANCE AND SOUND VELOCITY - 56

V. CONCLUSIONS -- 58

VI. SUGGESTIONS FOR FURTHER RESEARCH ------------------------ 60

APPENDIX A. DATA FOR SURVEY AREA OBTAINED FROM OTHER SOURCES -- 62

APPENDIX B. HORIZONTAL CONTOUR CHARTS OF BEAM TRANSMITTANCE, TEMPERATURE, AND COULTER COUNT -------------------- 74

APPENDIX C. VERTICAL SECTIONS OF BEAM TRANSMITTANCE-COULTER COUNT, BEAM TRANSMITTANCE-TEMPERATURE, AND TEMPERATURE-COULTER COUNT ------------------------ 90

1. VERTICAL SECTIONS PERPENDICULAR TO THE COASTLINE -- 90

2. VERTICAL SECTIONS PARALLEL TO THE COASTLINE -- 115

APPENDIX D. DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE AT SELECTED STATIONS ---------------------------------- 140

APPENDIX E. BATHYTHERMOGRAPH DATA ---------------------------- 150

1. EXPENDABLE BATHYTHERMOGRAPH TRACES ------------ 150

2. MECHANICAL BATHYTHERMOGRAPH FEATURES ---------- 156

APPENDIX F. CRUISE SUMMARY ------------------------------------ 158

1. CRUISE NARRATIVE ------------------------------ 159

2. EQUIPMENT UTILIZED ---------------------------- 161

APPENDIX G. STATION PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY -- 165

BIBLIOGRAPHY -- 310

INITIAL DISTRIBUTION LIST -------------------------------------- 312

FORM DD 1473 -- 317

LIST OF TABLES

Table Page

1 Station Positions and Weather Data -------------------- 238

2 SV/T/D Probe Depth, Temperature, and Sound Velocity Data -- 250

3 Beam Transmittance Data ------------------------------- 272

4 Coulter Particle Count Data ---------------------------- 283

5 Salinity Data -- 309

LIST OF FIGURES

Figure Page

1 Stations Occupied During Bay-Delta Study and Proposed Outfalls -- 17

2 Sewage Outfalls and Flow in Millions of Gallons per Day -- 19

3 Stations Occupied 10-18 May 1969 -------------------- 22

4 Day/Night Stations ---------------------------------- 24

5 Bottom Water Sampler Assembly Schematic ------------- 30

6 Vertical Cross Sections Studied --------------------- 37

7 Proposed Current Flow in Near Surface Waters --------- 42

8 Station Beam Transmittance-Particle Count Correlations -- 49

9 "Excellent Correlation" of Beam Transmittance vs Coulter Count Scatter Plot ------------------------- 50

10 "Good Correlation" of Beam Transmittance vs Coulter Count Scatter Plot ---------------------------------- 51

11 "Fair Correlation" of Beam Transmittance vs Coulter Count Scatter Plot ---------------------------------- 52

12 "Poor Correlation" of Beam Transmittance vs Coulter Count Scatter Plot ---------------------------------- 53

13 Relative Coulter Pulse Levels for 6-14 μ Latex Spheres -- 55

14 Sound Velocity vs Beam Transmittance Scatter Plot ---- 57

FIGURES OF APPENDICES

Appendix A

15 Monthly Mean Surface Pressure and Wind Patterns Off the West Coast of the United States ----------------- 63

16 Average Surface Water Temperature at Pillar Point Study Site -- 64

17 Average Surface Water Temperature at Ano Nuevo Study Site -- 65

18 Average Surface Water Temperature at Sandhill Bluff Study Site -- 66

19 CALCOFI 1950-59 Mean 10 Meter Temperature -------------- 67

20 Typical Temperature Profiles at Kaiser Study Sites ----- 68

21 CALCOFI 1950-59 Mean 10 Meter Salinity ----------------- 69

22 Surface Currents During Upwelling Period --------------- 70

23 CALCOFI 1950-65 Mean Geostrophic Flow at the Surface --- 71

24 Airborne Infared Radiation Thermometer Surface Contours (°C) for 2 May 1969 ---------------------------- 72

25 Airborne Infrared Radiation Thermometer Surface Contours (°C) for 19 June 1969 -------------------------- 73

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I. INTRODUCTION

A. PURPOSE

The recent rapid increase in the application of oceanography to solve military, economic, and recreational problems has dictated a need for additional data on various properties of the sea. One branch of oceanography that is able to assume a significant role in solving these problems is optical oceanography. The inherent optical properties of sea water and the distribution of underwater light, which are intimately related to the physical, chemical, biological, and dynamic conditions of the sea, can be used to characterize water masses. A number of investigations have been conducted to delineate the relationships between the optical properties of the sea and other oceanographic parameters, in order that optical measurements may become more useful in the study of the world's oceans. One such investigation, involving a specific optical parameter, light attenuation, was conducted in Monterey Bay late in the summer of 1968 [21].[1]

The present study involves an extension of that work. The initial goals were: (1) to provide detailed information on the distribution of light transmissivity in the coastal waters immediately to the north of Monterey Bay; (2) to further investigate correlations between light attenuation and other oceanographic parameters; (3) to determine coastal influences on the optical properties in the region; (4) to investigate the movement of particulates along the coast between San Francisco Bay and Monterey Bay; and (5) to study the near bottom profile of particulate matter.

---

[1] Numbers in brackets refer to the listing in the Bibliography and the page number of the item cited.

To achieve these goals 79 oceanographic stations were occupied in the region of interest, and the following specific parameters were obtained during the period 10 to 18 May 1969: Beam transmittance, sound velocity, depth, temperature, salinity, and size distribution of suspended particulates.

Upon completion of the program of observations it became apparent that the present work would provide the first extensive detailed study of the coastal waters between San Francisco Bay and Monterey Bay -- waters which are being considered seriously as future sites of major oceanic sewage outfalls [17].

B. BACKGROUND

To interpret the optical properties of natural waters it is necessary to understand the primary factors affecting the propagation of light in these waters. The ocean is an absorbing and scattering medium for light [12,p1]. The scattering is caused by the water itself and by suspended particulate matter, while absorption is caused by the conversion of light energy into heat. A beam transmissometer[2] is an instrument having its own light source and receiver, which can be used to measure the total light attenuation, including both scattering and absorption losses over a fixed path length. Such an instrument can be very useful in the study of coastal waters [8,p74].

The influence of suspended particulates on light attenuation can be observed. The sources of particulates in the ocean have been pointed out by Jerlov [7,p73]. They can be living organisms, detritus, inorganic or organic material from land or the bottom of the ocean, and airborne terriginous dust. Burt [4] in his study of Chesapeake Bay indicates wind mixing and tidal scouring as mechanisms for the introduction of particulates to shallow water. Fukuda [6] has noted the influences of irregular topography on attenuation. An increase in sea water light transmissivity and a decrease in particulate content with increasing distance from shore and influences associated with the coast have been observed [3].

---

[2] A beam transmissometer may be also called a beam attenuation meter or "c-meter". It is sometimes called an "alpha-meter". This is pointed out because a firm basis of definitions, applicable to optics in the sea, has not been fully adopted. As a result, a confusing use of terminology in the literature has sometimes occurred. The UNESCO Committee on Radiant Energy in the Sea recognized the need for standardization of definitions and introduced specific terms to be used [11,p3]. For the purpose of clarity, the UNESCO definitions are followed in this paper.

The intensity of a beam of light, I, received from a source, I_o, which has traveled over a path length, x, and has been subjected to absorbing and scattering losses is given by: $I = I_o e^{-cx}$. c is understood to be the sum, $c = a + b$; a represents the effects of absorption alone, while b represents the effects of scattering. For a one meter path length, $x = 1$ m, and $I = I_o e^{-c}$. Transmissivity per meter is defined as $T = I/I_o = e^{-c}$, while percent transmissivity is $100\ I/I_o = 100e^{-c}$, if the units of c are m^{-1}.

The horizontal and vertical distribution of suspended material results in characteristic optical signatures for given regions of the oceans. The horizontal patterns of suspended material in coastal waters may be highly complex and are governed by wind drift currents, tides, and land runoff [4,10]. The vertical distribution of particulate matter as measured by optical means has been discussed extensively by Jerlov [11], Fukuda [6], and Joseph [12]. It should be noted that the majority of particles generally tend to collect in the pycnocline, but since the pycnocline is very often determined mainly by the temperature structure, one finds particle maxima associated with the thermocline. Ball and Lafond [2] noted that the particulate maxima could occur either at the top of bottom of the thermocline. Joseph [13] has noted that during upwelling high particle content and low transmissivity can be expected, and that there is a need for more beam attenuation measurements in upwelling waters. In shallow water a logarithmic increase in particulates with decreasing distance to the bottom has been noted. But the observations have been inconsistent and the precise reasons for such an increase are still in question [12,p163]. Measurements in coastal waters have shown that the general horizontal and vertical distributions of particulates and attenuation are easily altered by topography, local winds, tides, and land drainage, and that patchiness is not uncommon [2,4,10,13]. This patchiness may make contours, based on the connection of single observations at various locations, misleading as compared to a time study of a given location.

The data of Yeske and Waer [21,p73] indicate that approximately 96 percent of the particulates affecting beam transmittance in Monterey

Bay were less than 8.5μ in diameter.[3] They found particle sizes to decrease with depth.

Another factor that must be contended with is the possible presence of dissolved substances which affect absorption. Such dissolved matter is often referred to collectively as "yellow substance" or "Gelbstoff" [12,p169]. Since yellow substance is presumably formed from decomposed organic matter, it can be expected that land drainage is a potential contributor to its presence in coastal waters. Jerlov also points out, however, that it has appeared in areas of upwelling that are free of coastal influences [12,p53].

A less important pigment which directly affects optical properties is chlorophyll A. This is the most abundant type of chlorophyll found in green algae. Determination of this substance can aid in determining biological activity and, thus, possibly account for particulate maxima. Fair correlation between chlorophyll content and transparency, as determined from Secchi disc readings, has been obtained [14].[4]

Land drainage has been mentioned as a factor which influences the optical properties of the ocean. Optical investigations in general have considered only river flow as a drainage source. The utilization of natural bodies of water as sumps for sewage effluent has increased tremendously with the growth of communities and industries. As a result of this, the transparency of near shore waters has received considerable attention [18,p28].[5] Perhaps the one most concerned with this problem is the marine biologist who considers that decrease in water transmissivity may be one of the biggest factors associated with ecological changes, for the light available for photosynthesis is then reduced. Thus, beam transmittance measurements are of the utmost importance to marine waste disposal research. In general there exists a need for more transmissivity data to evaluate the effect of waste on the receiving waters [12,p163,18,p29].

---

[3] This value is different from that given by those authors. The reason for the correction is given on page 56 .

[4] Tyler has written a very worthwhile paper concerning the accuracy and use of the Secchi disc in making attenuation measurements [19].

C. OCEANOGRAPHIC CLIMATOLOGY

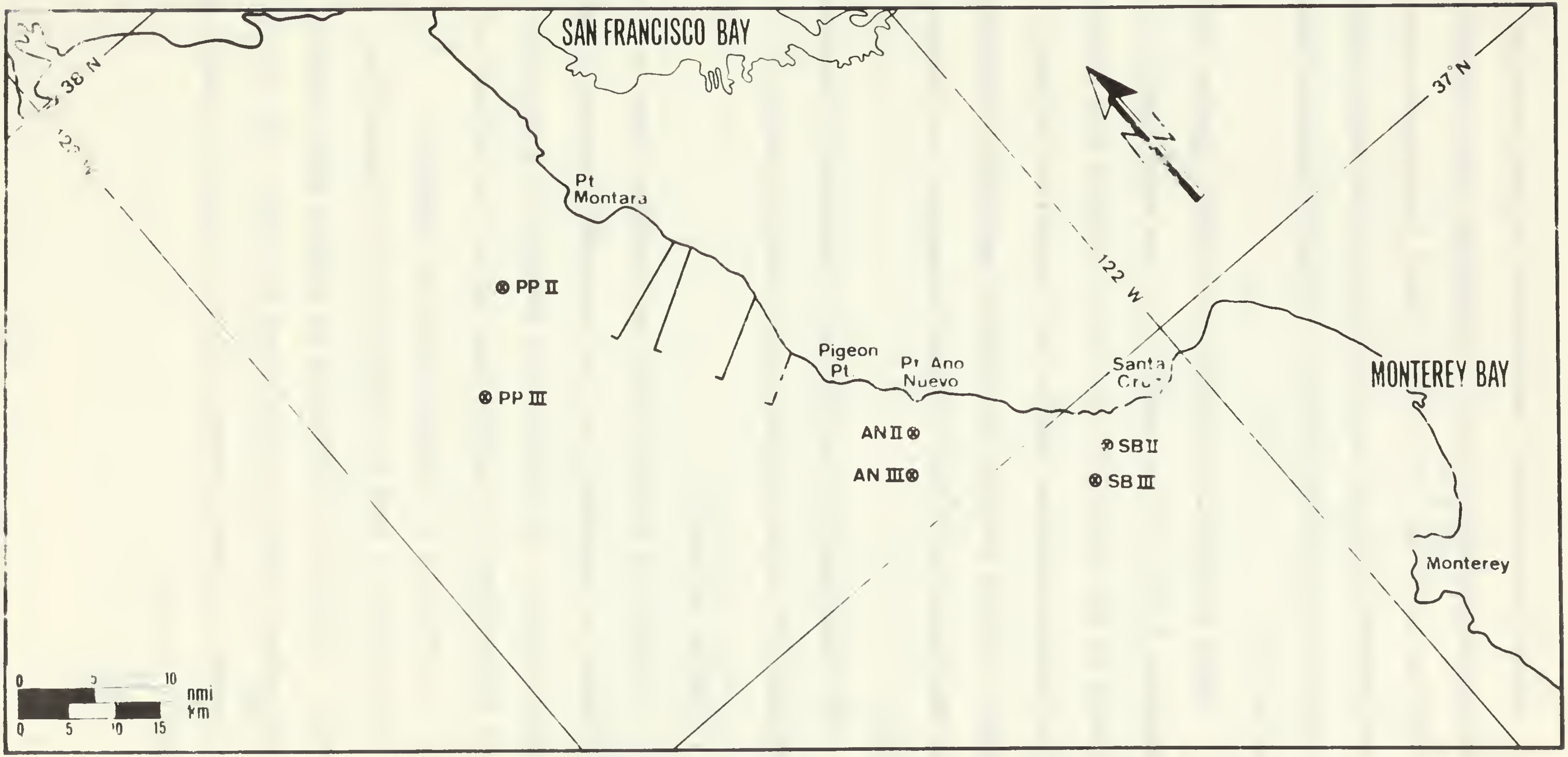
The area of study is located in the California Current, which flows southeastward between a cell of high atmospheric pressure to the west and one of low pressure to the east, and which is described in detail by Reid, et al. [15]. Upwelling generally occurs in the region from April through August at a time when the two cells become more intense and move closer together [Appendix A, Fig. 15], and is strongest in the study area from May through July [15,p30]. It was anticipated that near surface measurements of low transmittance, high particulate count, high chlorophyll, low temperature, and low salinity would be observed in areas of upwelling. Winds were expected from the north and northwest.

In an effort to establish an oceanographic climatology for the study area during the period of survey that could be used for comparison with cruise data, it was found that past detailed measurements were extremely scarce. The past data that was found [Appendix A] is from the California Cooperative Oceanic Fisheries Investigation (CALCOFI) Atlases [5,20] and the Final Report of San Francisco Bay-Delta Water Quality Control Program [17]. The latter report was undertaken to review and collect oceanographic data along the coast from just north of San Francisco to Monterey Bay in order that a decision could be made as to where to place major sewage outfalls to handle the increasing waste disposal problem in the San Francisco Bay-Delta region. The study was conducted by the firm of Kaiser Engineers with assistance from various State and Federal agencies in an area within the region of interest of the present work. Figure 1 indicates the stations occupied during the Kaiser study. The geographical landmarks adjacent to the ocean stations occupied by Kaiser were Pillar Point (PP), Point Ano Nuevo (AN), and Sandhill Bluff (SB). Measurements for the Kaiser report were gathered on several days a month from July through December 1967.

---

[5] The term transparency is often employed loosely. It is used here to indicate the depth at which a Secchi disc ceases to be distinguishable from the field of upwelling light in the ocean.

Monthly average surface temperatures obtained from ocean surface isotherm charts published by Tiburon Marine Laboratory, U. S. Bureau of Sport Fisheries and Wildlife, for the region are shown in Appendix A, Fig. 16-18 [16,Fig.VII-6,VII-7,VII-8]. Surface temperature at all the station locations is lowest in March and increases through May. The CALCOFI ten-year mean temperature data for a depth of 10 meters is shown in Appendix A,Fig. 20[4].The lack of detail for the region of interest (indicated by shading) is easily seen. A temperature increase for this region through May may be inferred. This rise in temperature as shown by past data was not considered high enough to discount the possibility of encountering upwelling during the period of study. Representative temperature profiles for the upwelling period at the Kaiser stations are shown in Appendix A, Fig. 20 [17, Fig. VII-11]. It should be noted that these profiles are for the latter part of the upwelling period.



Stations occupied during Bay-Delta Study and Proposed Outfalls

Figure 1

Monthly mean salinity measurements at North Farallon Island, California, and Pacific Grove, California, show increasing salinity beginning about one month after minimum temperatures occur. CALCOFI ten-year mean salinity data for a depth of 10 meters, shown in Appendix A, Fig. 21, indicate an increase in salinity occurring through the spring [5].

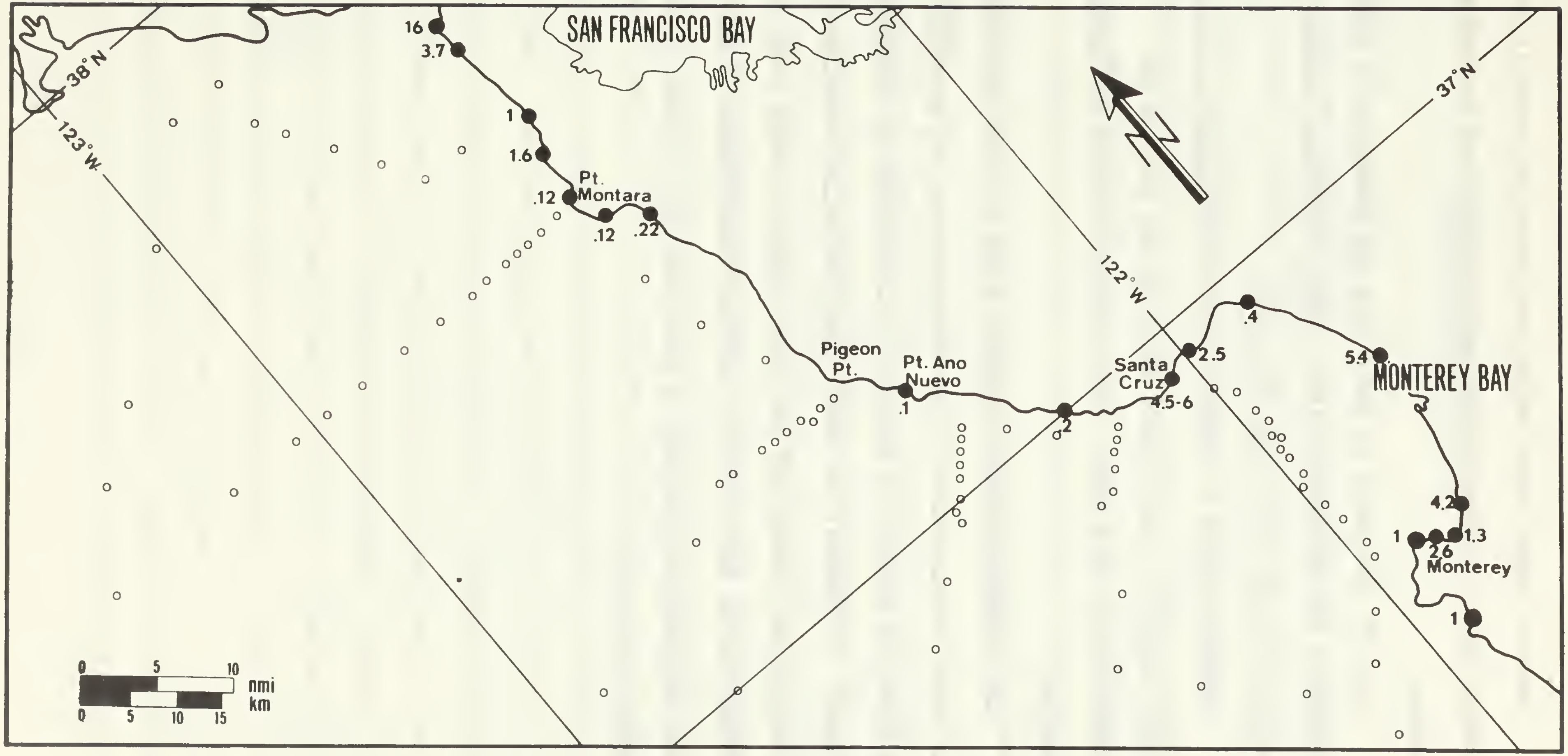
During the upwelling period, the offshore current direction [Appendix A, Fig. 22] is primarily to the south, while nearshore the flow is to the north [17, Fig. VI-8]. Special note should be taken of a counter-clockwise current cell located to the south of Pt. Ano Nuevo. CALCOFI ten-year mean surface geostrophic current measurements for May [Appendix A, Fig. 23] tend to support this current description [20].

No transmissivity, particulate, or chlorophyll measurements are available for comparison during the upwelling period in this area.

D. COASTAL INFLUENCES

Past work has indicated that one must not ignore such coastal influences as topography and land drainage in optical studies of coastal waters. The coastal area involved in this survey extended from the entrance of San Francisco Bay to the Northern end of Monterey Bay -- a total of 107 nautical miles of shoreline.

The shoreline from San Francisco Bay to Pigeon Point is high and rocky. The coast is broken only by several small streams. There are seven sewage outfalls located along the coast. All outfalls in the study area with their average flow in millions of gallons per day are plotted in Fig. 2.



Sewage outfalls and flow in million gallons per day

Figure 2

Between Pigeon Point and Pt. Ano Nuevo the coast is low and rocky. Several small streams and one sewage outfall are located between these points.

From Pt. Ano Nuevo to Santa Cruz the shoreline is composed of sanddunes and sandstone cliffs. Again only small streams and two sewage outfalls drain into the waters.

Monterey Bay is a semi-elliptical bay having low shores and sandy beaches. Three rivers enter the Bay but are not considered in this study. Seven sewage outfalls are located within the Bay.

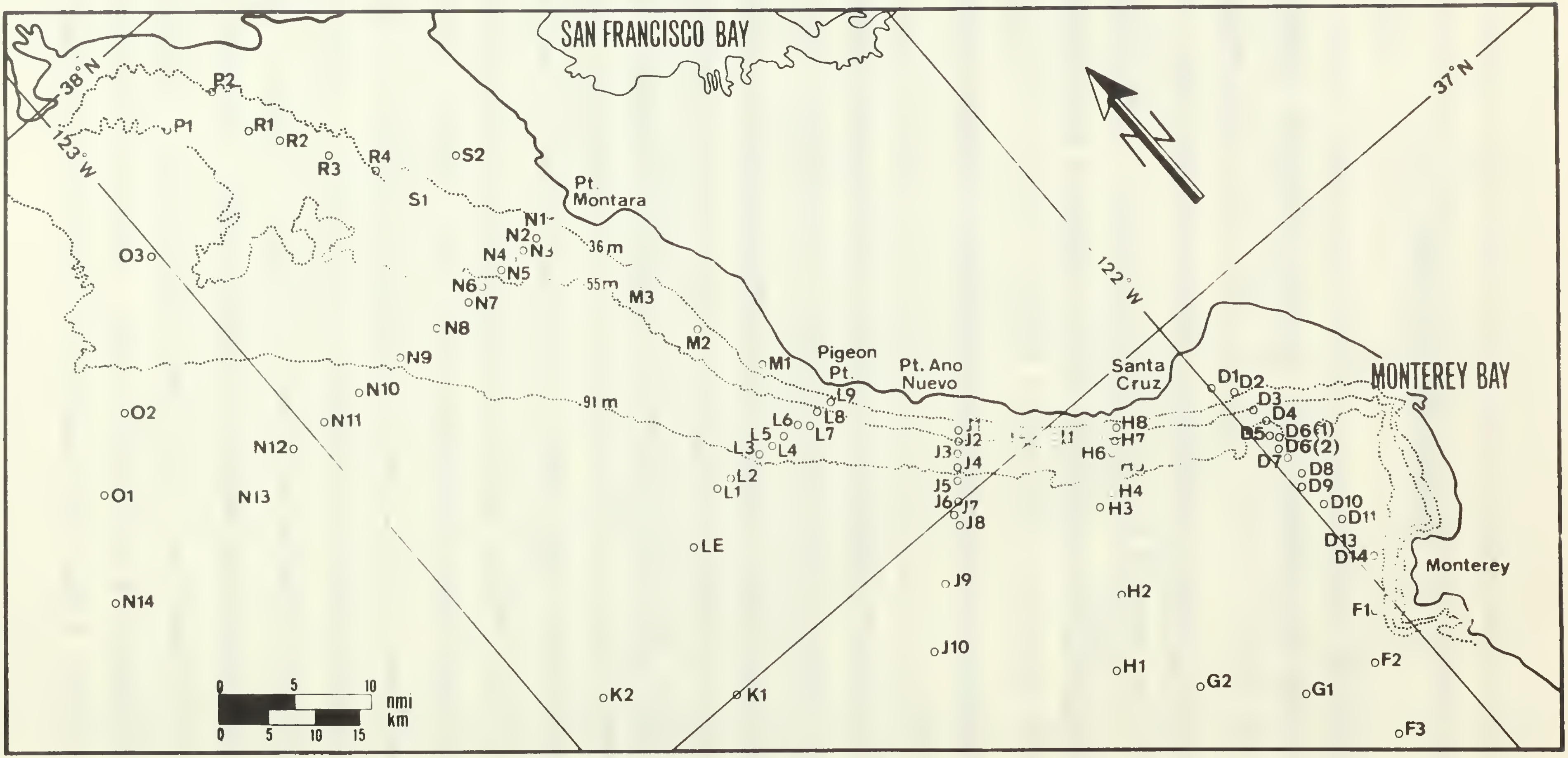
The offshore bottom topography shows that the continental shelf is about 26 miles wide off San Francisco Bay and gradually narrows to 6 miles off Santa Cruz where it is interrupted by Monterey Submarine Canyon. In general the shelf along the entire coastline consists of sand and mud, except off the rocky coastline where rocky bottoms extend out to about 1 mile. Detailed descriptions of the geological and topographical features of this area can be found in the Kaiser report [16,pIV-1].

II. OBSERVATIONAL PROCEDURES

A. CRUISE PLAN

The study was conducted aboard the USNS DE STEIGUER (T-AGOR 12) during the period 10-18 May 1969. The study area was the entire coastal water region between San Francisco and Monterey Bays. Station selection was based on the following criteria: To occupy stations throughout the entire study area; and to provide as much station density as possible in order that a detailed picture of the optical characteristics of the coastal waters affecting Monterey Bay could be obtained.

The cruise was limited to eight days, and thus a preliminary survey technique such as that utilized by Jerlov in the Adriatic [10], while desirable to optimize station location, was not feasible. Therefore a series of 87 stations along tracks extending from the coastline were decided upon. The lengths of station lines were chosen such that the furthermost stations would be relatively free of near shore influences. Station lines were taken across the entrances to San Francisco and Monterey Bays. Station spacing was approximately one mile near the coast and from three to five miles farther out. Figure 3 shows the position of each station. Table 1 contains the positions at the beginning and completion of sampling at each station. Station lines were occupied in alphabetical order, D through S. Stations within a given station line were sampled in numerical order. The first station of the cruise track was D-1; the last station was S-2. Station positions were determined by a RCA CRN-NIC-75 radar. Position accuracies vary from ± 0.5 to ± 1 nmi. The location of the vertical cross sections



Stations occupied 10-18 May 1969

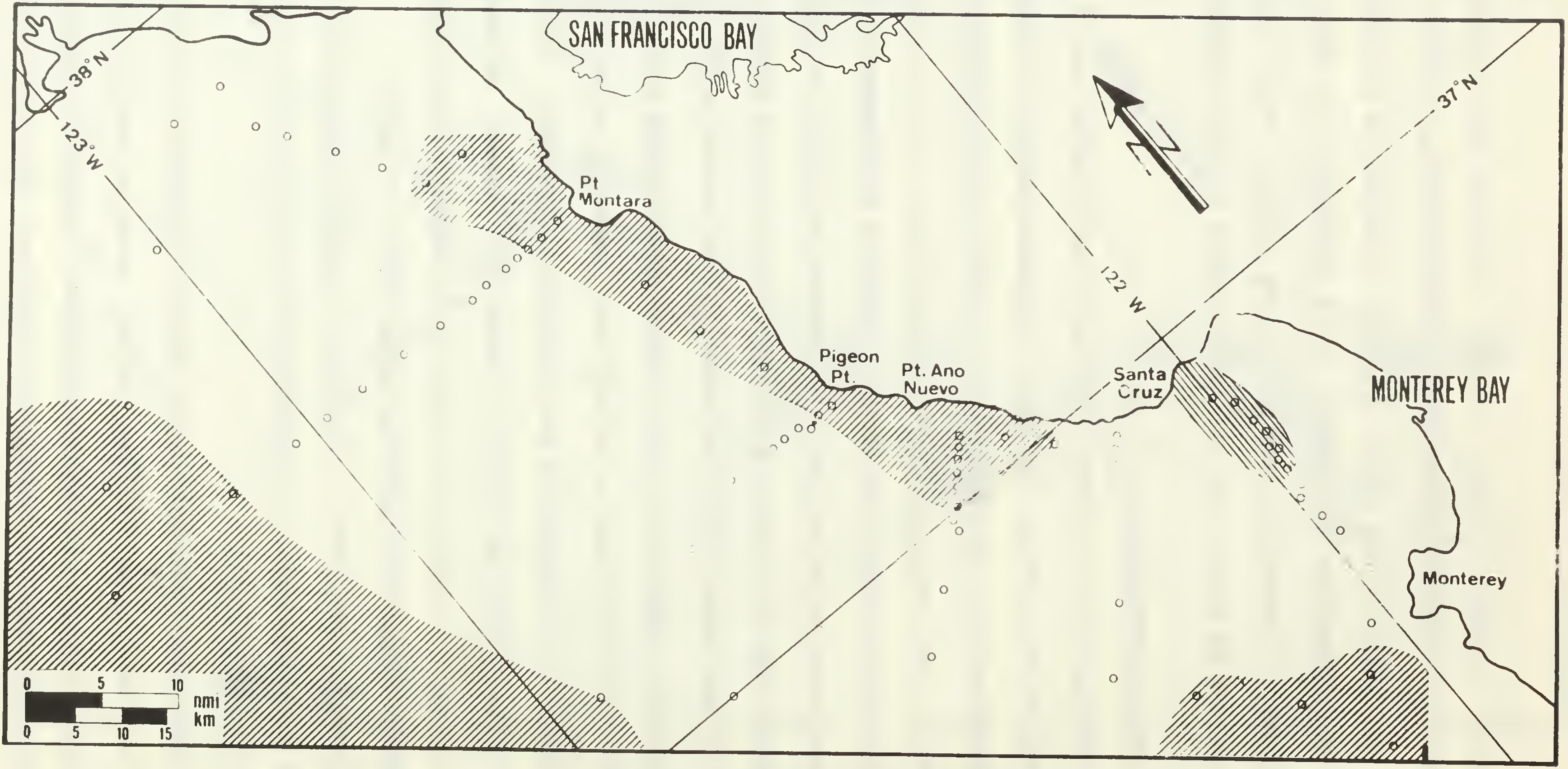
Figure 3

examined are shown in Fig. 6. Figure 4 indicates which stations were occupied during daylight hours and which during nighttime. For the purpose of the figure, daylight is defined as 0600-2000 hrs Pacific Daylight Time (PDT). It is presented as an aid in interpreting transmission and particulate profiles, which could be affected by marine life undergoing diurnal vertical migration.

B. SAMPLING PROCEDURES

The basic plan for data collection at each station was to make a total of three casts. The first cast would consist of a beam transmittance meter (c-meter), sound velocity-temperature-depth probe (SV/T/D), and a salinity-temperature-depth probe (S/T/D) on 4HO wire. This technique would allow for a simultaneous measurement of beam transmittance, sound velocity, temperature, salinity, and depth. Readings were to be taken on both down and up cast to determine if beam transmittance changed noticeably. Upon evaluation of the light attenuation readout, teflon-lined Nansen bottles would be placed on 3/16" hydrographic wire to collect water samples at selected depths of interest for particulate and chlorophyll A analysis. The third cast would consist of lowering a bottom water sampler, designed by the author, to collect near bottom water samples for particulate analysis. Expendable bathythermographs (XBT), mechanical bathythermographs (MBT), and protected reversing thermometers were to be utilized at various stations for calibration checks on the SV/T/D and S/T/D.

The actual field work did not coincide completely with the initial plan due to equipment failures, battery charge requirements, shortage of time, and better techniques discovered. Appendix F presents a cruise summary and a table illustrating the equipment used at each station.



Day/Night Stations

Figure 4

When the water sample cast was retrieved, chlorophyll and particulate samples were drawn from the Nansen bottles. Particulate samples were preserved in 200 ml plastic bottles with 10 ml of Lugol's iodine solution [20,p99].[6] Chlorophyll samples were prepared by filtering about one ml of water through Whatman GF/C glass fiber filters. The filters were folded, placed in plastic bags, and immediately frozen. Magnesium carbonate was added to prevent acidity and subsequent pheophytin formation [16]. Some 524 particulate samples and 470 chlorophyll samples were taken.

The temperature profiles resulting from the 17 XBT casts which were made are contained in Appendix E1, while the major features of the temperature structure obtained from the 7 MBT casts which were made are contained in Appendix E2.

The seas were calm and the sky was overcast during the entire cruise. Winds were light and variable from the beginning of the cruise until the midway point after which they were predominately from the northwest. Weather data were taken every four hours and are included in Table 1.

---

[6] The formula for Lugol's iodine solution is: 1 g iodine and 3 g potassium iodide per 300 cm^3 distilled water. Following preparation the solution is filtered through 0.45 μ millipore filters.

III. EQUIPMENT DESCRIPTION

A. BEAM TRANSMISSOMETER

A Marine Advisors Model C-2 c-meter was used throughout the study. This is the same type of instrument used and described by Yeske and Waer [20,p15]. One correction to their description of the instrument is that the selenium photovoltaic cell used by them, as well in the present work, was an International Rectifier 49-1260 rather than an International Rectifier DP-2.

The optical filter arrangement was identical to that used by Yeske and Waer. That is, Eastman Kodak Wratten 61 gelatin filters were used in conjunction with Schott BG-18 filters for reduction of optical bandwidth and minimization of coastal water absorption and elimination of infared during air calibration.

B. SOUND VELOCITY-TEMPERATURE-DEPTH SYSTEM

A Ramsey Engineering Co. Mk-1 Deep Sea SV/T/D probe was used extensively throughout the cruise. It is a battery operated instrument which measures sound velocity, temperature, and pressure directly. Data are transmitted to shipboard equipment through electrical conducting cable as frequency modulated tones and can be displayed in both analog and digital form. The instrument probe is 25 inches in overall length and weighs 78 pounds in air. It can withstand a maximum pressure of 10,000 psi.

Sound velocity is measured directly by the "sing-around" method [7]. A 4 MHz pulse of sound is generated and transmitted through the water over a path of fixed length to a receiving transducer where it is amplified and caused to generate a new sound pulse. A sound path length of 25 cm is employed.

Temperature is sensed by a pair of thermistors located near the center of the sound path. These themistors are part of the resistive branch of the frequency determining network of a Wien bridge temperature oscillator. A special compensation network is used to linearize and fit the frequency-versus-temperature characteristics.

Depth is determined as a function of pressure, which is measured with a Vibrotron pressure transducer.

The manufacturer's specifications state that the sound velocity is 1400 to 1600 meters per second with an accuracy of ± .02 meters per second; temperature range is -2°C to +30°C with an accuracy of ± .02°C; the depth is measured to within ± .25% of the actual depth.

C. SELF-CONTAINED SALINITY-TEMPERATURE-DEPTH MEASURING SYSTEM

A Bisset-Berman Model 9030 S/T/D was used in the investigation. The system is a completely self-contained, battery operated, in situ instrument which measures and records in digital form salinity, temperature, and depth data by means of an incremental tape recorder. It was lowered for casts on nonelectrical hydrographic wire. The instrument weights 120 pounds in air and has an overall length of 37 inches. Its maximum depth limit is 4000 meters.

Unfortunately the cap of the instrument housing was designed for quick removal. Two cap retaining screws are attached to opposite sides on the outside of the housing, which pivot into slots in tabs which project from either side of the cap. The cap is then held in place by large wing nuts which project a considerable distance above the top of the cap. Had the two cap retainer screws and wing nuts been less exposed, the instrument would not have flooded (see Appendix F1). It is strongly recommended that such caps be modified for any future work.

Salinity is determined in the S/T/D by sensing conductivity, temperature, and pressure in a bridge circuit which as an output error signal that is a function of salinity only. Conductivity is detected by means of an inductively-coupled sensor which uses seawater to form a conducting loop common to two coaxial toroidal inductors. The primary temperature compensation circuit consists of a double bridge network incorporating two precision platinum resistance thermometers for measuring seawater temperature. A secondary compensation circuit compensates for the fact that the primary temperature compensation circuit is only accurate at a salinity of $35^{0}/_{00}$. It is connected in series with the output of a balance amplifier and the primary temperature circuit. The result is that the output of the balance amplifier is the sum of both temperature circuits and is independent of temperature for all values of salinities. The pressure compensation circuit simulates fractional increases in conductivity with pressure at any temperature. This is accomplished by the pressure transducer which supplies an amplifier input proportional to pressure. The gain of the amplifier is determined by a negative feedback circuit containing a thermistor. This results in a gain which varies with temperature.

The temperature measuring circuit consists of a temperature sensing bridge having sensitivity and zero-adjust circuits. The sensing element is a platinum resistance thermometer.

The pressure measuring circuit consists of a pressure-sensitive strain gage bridge with zero and range adjustments.

The incremental tape recorder is a 7-track, IBM compatible recorder, capable of holding up to 100 feet of half inch wide magnetic tape. Total capacity is 200,000 characters, while the recording rate is 50 characters per second.

According to the manufacturer, the salinity measurement range is 31 to 36°/₀₀ with an accuracy of ± .02°/₀₀; temperature is measured from 2°C to 27°C to an accuracy of ± .026°C; and depth is measured with an accuracy of ± .25% of the depth.

D. BOTTOM WATER SAMPLER ASSEMBLY

A sampler was designed to investigate the near bottom particulate profile by taking water samples at precisely known heights above the bottom. The assembly consists basically of two coaxial steel pipes and attached water collection bottles. A schematic of the sampler is given in Fig. 5 (note that the diagram is not to scale).

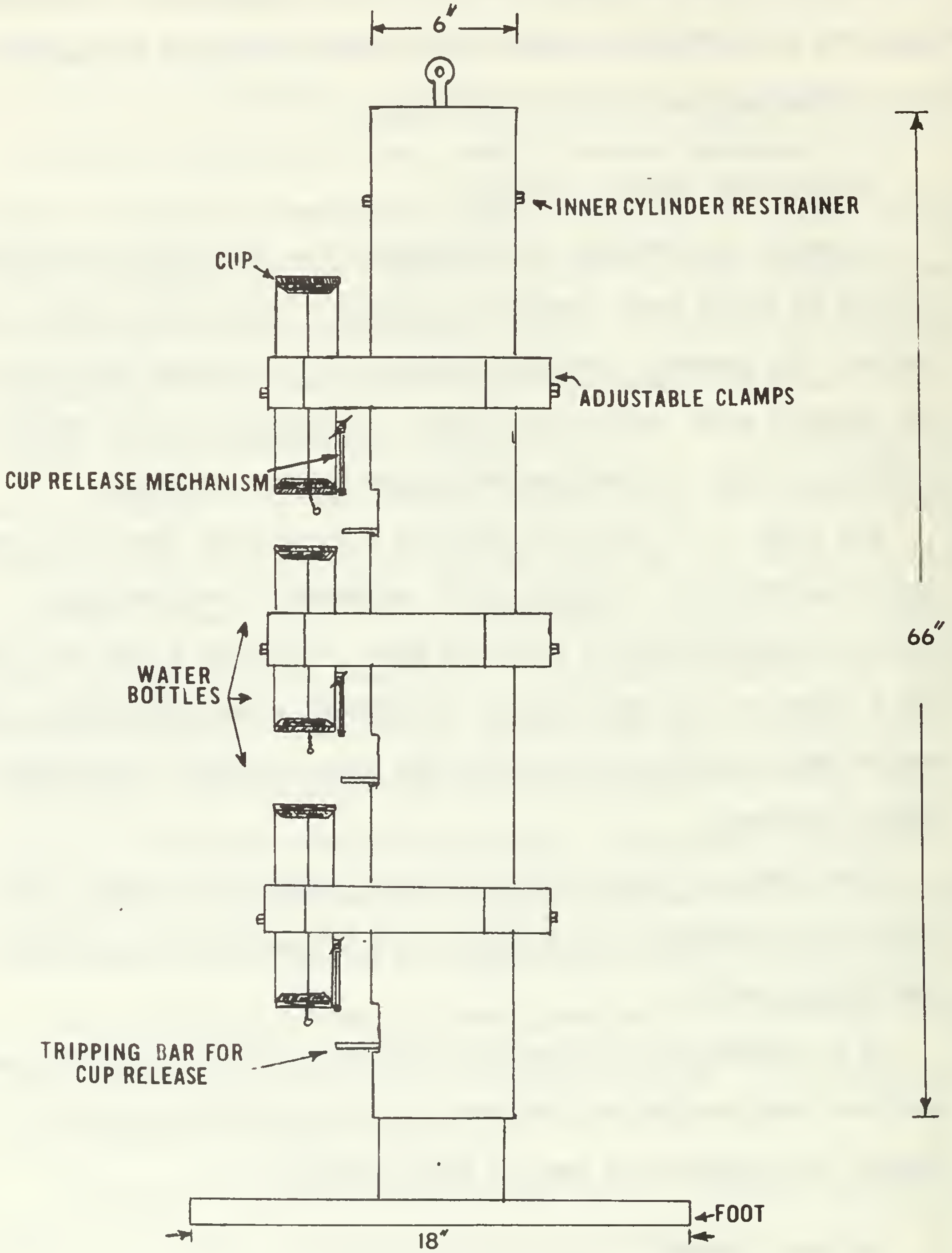
The inner 3 1/2 inch O.D. pipe has a one-quarter inch thick steel disc attached to it. Tripping bars, attached to the inner pipe, protrude through slots in the outer pipe. The outer 4 inch O.D. pipe has a padeye at its upper end for attachment to the hydrographic wire and an inner restrainer from which the inner cylinder is suspended during lowering.

Three Kahl one liter plexiglass water samples were used. The bottles were inverted on the sampler and tripped simultaneously by the tripping bars.

It is assumed that the sampler strikes the bottom vertically and provides water samples at distances 20, 70, and 120 cm above the bottom. The sampler was used at three stations.

E. COULTER COUNTER

A model A Coulter Counter was used for particulate analysis. This was the same instrument used and described by Yeske and Waer [20,p15].



SCHEMATIC OF
BOTTOM WATER SAMPLER ASSEMBLY
(NOT TO SCALE)

Figure 5

The measurement procedures followed were similar to those of Yeske and Waer, with the exception that the entire assembly was surrounded with a copper screen to eliminate outside electrical interference, which could lead to false counts. A gain setting of four was used.

The final sample for a given day was run as the first sample for the following day, in order that any instrument malfunctions could be determined.

F. EXPENDABLE BATHYTHERMOGRAPH SYSTEM

A Sippican XBT system was used periodically during the cruise. The basic units of the system are an expendable probe, a launcher, and a recorder.

The probe consists of ballistically shaped housing containing a calibrated thermistor connected to a spool of wire. When the XBT is launched, the wire unwinds allowing it to fall at a constant predetermined velocity without being affected by the forward speed of the ship.

The recorder is a conventional chart type and has a null-balance positioning system. Since the rate of descent of the XBT is known, depth is recorded directly on the time axis of the chart.

The manufacturer's specifications state that the temperature range is -2°C to +35°C with an accuracy of ± .2°C and depth range is 1500 feet with an accuracy of ± 2% or 15 feet, whichever is greater.

G. MECHANICAL BATHYTHERMOGRAPH

A Type OC-1 (200 ft) Naval Oceanographic Office MBT was utilized periodically during the cruise at shallow stations.

IV. ANALYSIS OF OBSERVATIONS

A. INTRODUCTION

Since throughout the cruise several instruments were used to measure the same parameters, instrument evaluations were required. This undertaking resulted in the decision to disregard all S/T/D data. The reasons for this decision were based on comparisons (not shown) of temperature profiles at stations during which XBT, SV/T/D, and S/T/D casts were made and of salinity data as obtained by means of Nansen casts. This unexpected performance resulted in the availability of salinity data at only four stations (Table 5).

Because of time requirements, chlorophyll samples have not been analyzed at the time of writing.

The purposes of this research have dictated that the data be utilized to describe the optical properties of the study area during the upwelling period of the California Current System; and to correlate the several measured oceanic parameters with light attenuation. To accomplish these tasks data have been presented in the form of horizontal and vertical contour charts, station profiles, and relative-size distribution historgrams for particulates. In several cases the same figures are referred to in the description of the area and in the correlation of parameters.

Horizontal contours of beam transmittance, temperature, and particle count were made at depths of 0, 10, 20, 40, and 61 meters. The greatest depth is that selected for the proposed sewage outfalls shown in Fig. 1. Station positions are indicated on all the contour charts to show the density of points used in drawing isopleths. Intervals of isopleths were selected to illustrate as much detail as practicable. Particle count is plotted as 10^{-2} times the count per 2 ml sample. SV/T/D, XBT, and MBT data were used in temperature plots.

Vertical contours of beam transmittance, temperature, and particle count were also plotted. These contours were drawn separately and then transferred to each other in order to obtain beam transmittance-particle count, beam transmittance-temperature, and temperature-particle count overlays. Beam transmittance contours are plotted at 10%/m intervals, temperature at 0.5°C intervals, and particle count as required to optimize definition.

Appendix C presents the station profiles of beam transmittance, temperature, particle count, salinity, and calculated density against depth. For purposes of illustration Appendix D contains particulate size histograms for representative stations throughout the study area. Histograms for the remaining stations could be plotted using Table 4 on p. 283 - 308, which shows the Coulter count in relation to time, depth, and relative pulse heights.

B. AREA DESCRIPTION

1. Horizontal Contours

Appendix B presents contours of measurements made during 10-18 May 1969. There are two very distinct areas, which appear on all the charts and are of special interest. The first is located approximately 20 nautical miles (nmi) west of Point Montara and the second is just off the coast of Point Ano Nuevo.

An examination of the temperature structure at the Point Montara site reveals a core of cold water which extends from below 61 m to the surface. A spreading of this core occurs with decreasing depth. The particulate contours show a high count in approximately the same area at the surface and at 10 m, but at greater depths this feature disappears. Beam transmittance isolpleths illustrate the same type of behavior as do those for particulates. Low transmissivity occurs in the region of interest down to 10 m, but by 20 m this feature is no longer present.

Before concluding that the high particle count and low transmissivity are being caused by upwelled water, possible coastal influences on particle count and transmittance were analyzed. Two effects could influence this phenomenon, namely, the tidal flow from San Francisco Bay and the complex of sewage outfalls around Point Montara. The tidal prism for San Francisco Bay (i.e., the volume of water between high and low tide) is 50 X 10^6 cu. ft. Fifteen to twenty percent of the prism is replaced by new ocean water each tidal cycle. This is the principal mechanism by which pollutants are ultimately removed from the Bay. The average outfall of river water coming out of San Francisco Bay during the period of 10-18 May, as measured just within the Bay entrance, was 36,000 million gallons per day[1].The flow volume of the various coastal sewage outfalls are shown in Fig. 1.

While these coastal influences should have a pronounced effect on the near shore waters, the characteristics of low transmissivity, high particle count, and low temperature appear to be due to another cause. There are high particle counts and low transmissivity near the mouth of San Francisco Bay and near Point Montara, but both are separated from this area by lower particle counts and higher transmittance readings. It was also observed that the highest particle counts and lowest transmissivity occur in the area of the temperature low. The assumption is made that these coastal influences could be reaching this area, but it is concluded that upwelling exerts the greatest influence on these waters. Reid [15] has pointed out that salinity increases with depth, instead of the normal decrease to a minimum, in upwelling waters. All four salinity profiles show an increase in salinity with depth. The surface salinity at N-7 is the highest of the four, thereby adding credence to the conclusion this is an area of upwelling when considering the temperature, particle count, and transmissivity data. The requirement of northwest winds to produce upwelling was present during the period of observation as can be seen in Table 1.

It is proposed that the upwelling is coming up the continental slope from a depth of about 200 m. The depth suggested is based on the fact that at N-14 the temperatures at 201 and 303 m are 8.53 and 7.05°C respectively (see Table 2, p 268), while the lowest temperature recorded at N-10, which is in the center of the core, is 7.12°C at 98 m (see Table 2, p 266). As the upwelling water attempts to move toward the coast it is impeded by the natural southerly flow of the California Current and the flow from San Francisco Bay. This results in the complex spreading in the north and narrowing to the south. A conclusion is not made as to whether the upwelling is beginning or subsiding.

Looking at the temperature structure near Point Ano Nuevo, one notes the complexity of the situation. With no past models to guide the contouring, the final patterns drawn should not be considered as exact, as the data allowed various other patterns to be drawn. In all cases however, the contours were complex.

The isotherms maintain an interlocking pattern through the 20 m chart, from which the possibility of the meeting of water masses to a depth of at least 20 m may be inferred. Particulate contours suggest the same effect to 20 m, except for a high particle count at J-5 down to below 61 m. Beam transmittance contours are not as complicated, but a suggestion of water masses meeting is present. There is not a corresponding low transmittance for "good" correlation with the high particulate count at J-5. Examination of the vertical contours of Cross Sections 5, 11, 12, 13, and 14 [Appendix C2] reveals the possibility of interacting water masses and will be discussed in Section IV.B.2.b.

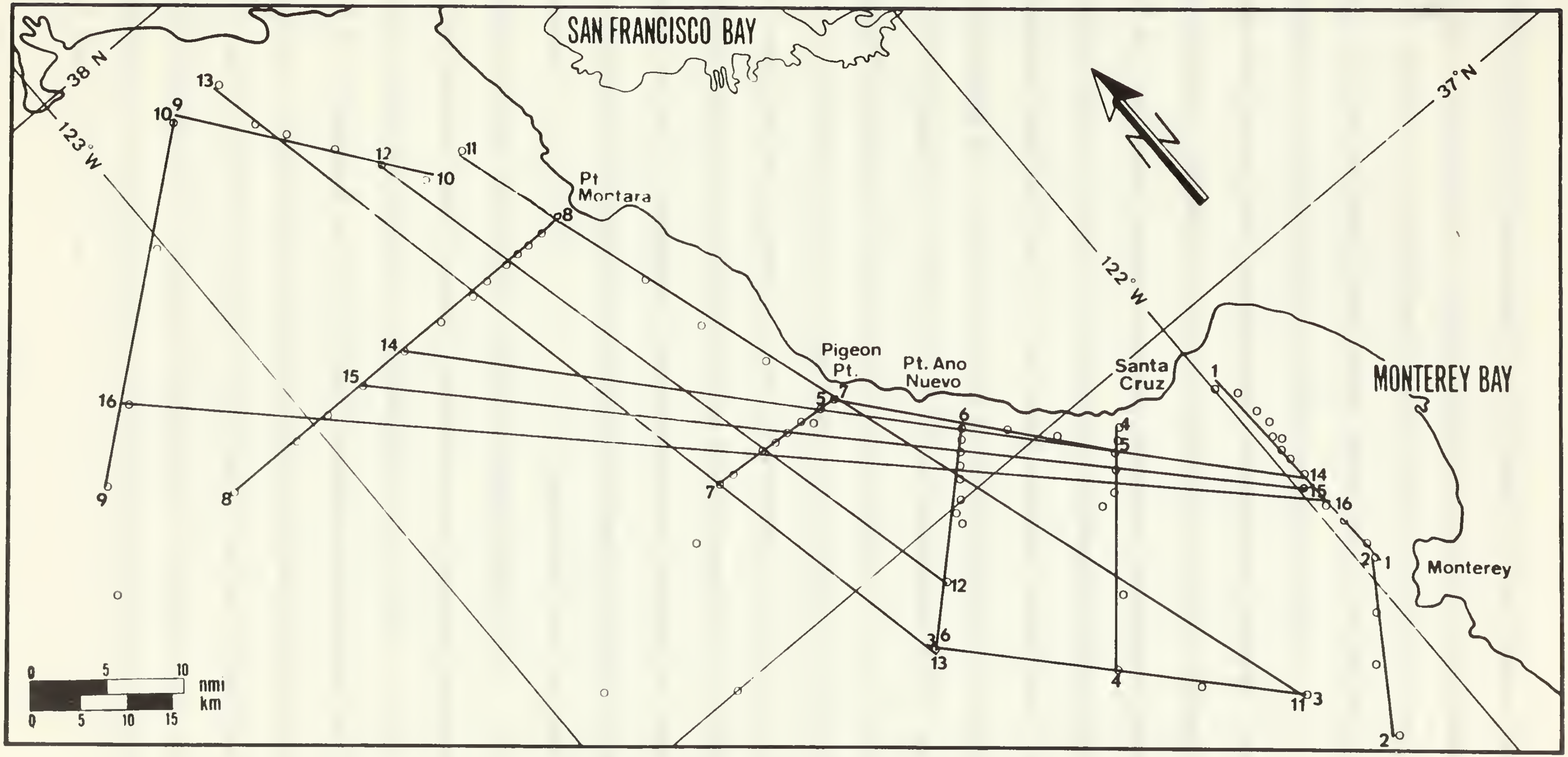
It is felt that the patterns which resulted are due to an eddy system at Ano Nuevo (previously mentioned in II.C.). Furthermore, it is concluded that this eddy system possibly exists to depths of 20 m. The reason for the particulate high at 50 m at J-5 is not known. There are no major outfalls or unusual topographic conditions existing at these stations to account for this high. Coulter counts were retaken for certain samples in this area, producing essentially the same results.

2. Vertical Contours

Vertical contours along lines approximately "parallel" and "perpendicular" to the coastline are examined. Figure 6 shows the cross sections considered. They are labeled 1 through 16, with the numbers appearing at the ends of the corresponding sections. "Perpendicular" cross sections are 1, 2, 4, 6, 7, 8, 9, and 10 are presented in Appendix C1, beginning at p 90, while "parallel" cross sections are 3, 5, 11, 12, 13, 14, 15, and 16 and are presented beginning at p 115 of Appendix C2.

a. Perpendicular Cross Sections

The 30, 50, and 70 percent beam transmittance isopleths are utilized to describe the area's waters as "turbid", "relatively



Vertical cross sections studied

Figure 6

turbid", and "clear" respectively. The cross sections will be examined beginning with the waters immediately to the northwest of Monterey Bay and proceeding up the coast to San Francisco Bay. Finally, the effect of the motion of these waters south toward Monterey Bay is discussed.

Cross Section 4 (p 97), to the southwest of Santa Cruz, shows a wedge of turbid water at depths of zero to eight meters at the coastline and at the surface at H-7. Relatively turbid water extended out along the surface to just beyond H-6. At this point it can be traced downward to a depth of 15 m at H-5. This depth marks where clear water intrudes from H-4. It is then seen between H-7 and H-8 at 25 m and down within 30 m of the bottom. Of particular interest is the 40% transmittance reading obtained at zero and two meters at H-2, a value which is significantly lower than for surrounding stations. Particulate counts at the same depths are higher than for encompassing water and are thus in accord with the transmissivity data. The 11.0 and 10.5°C isotherms display a distinct upward bulge at H-2 near the surface as compared to the remaining isotherms. This is suggestive of localized upwelling near this station,although the direction of flow is thus far not indicated.

At Cross Section 6 (p100) , south of Point Ano Nuevo, one notices an increase in the volume of turbid water extending out from the coast. Relatively turbid water is present at depths of 8-12 m out to J-5, while turbid water is found at J-3 to a depth of 15 m. A clear water intrusion reaches, from an average depth of 15 m, to a depth of 30 m between J-1 and J-2 and down to within 10-15 m of the bottom. Particulate isopleths and isotherms present an extremely difficult picture to analyze. A particulate high at Station J-9 is not supported by corresponding low transmissivity, nor do the isotherms indicate upwelling. The suggestion that an eddy system exists in this area has been made above and will be discussed later at p 41 .

Westward from Pigeon Point an increase of wider bands of turbid waters continues as seen in Cross Section 7 (p 103). Turbid water is found between L-2 and L-3 with an average depth of 18 m. Relatively turbid water exists at L-2 where it slants to a depth of 35 m at L-5. From this point it moves away from the shoreline 10-30 m above the bottom. Clear water intrudes between depths of 25 and 75 m to L-5. Particulate highs located at L-3, L-6, L-7, L-8, and L-9 in the upper 20 meters lie within the turbid band. The 9.5°C and higher temperature isotherms indicate the possibility of upwelling effects in the region of L-1, L-2, and L-3.

Turbid waters at Cross Section 8 (p 106), located to the west of Point Montara, probably extend no farther out than N-12; however, no beam transmittance measurements were taken at N-13 and N-14. Relatively turbid water appears at least to N-12 and follows the contour of the turbid water. Clear water intrusion reaches no closer than between N-8 and N-9 at 25 m. The pattern of isotherms between N-8 and N-12 distinctly shows the upwelling discussed in IV.B.1. on p 34 . The 9°C and lower isotherms indicate a flow of cold water up the continental slope from depths below 100 m.

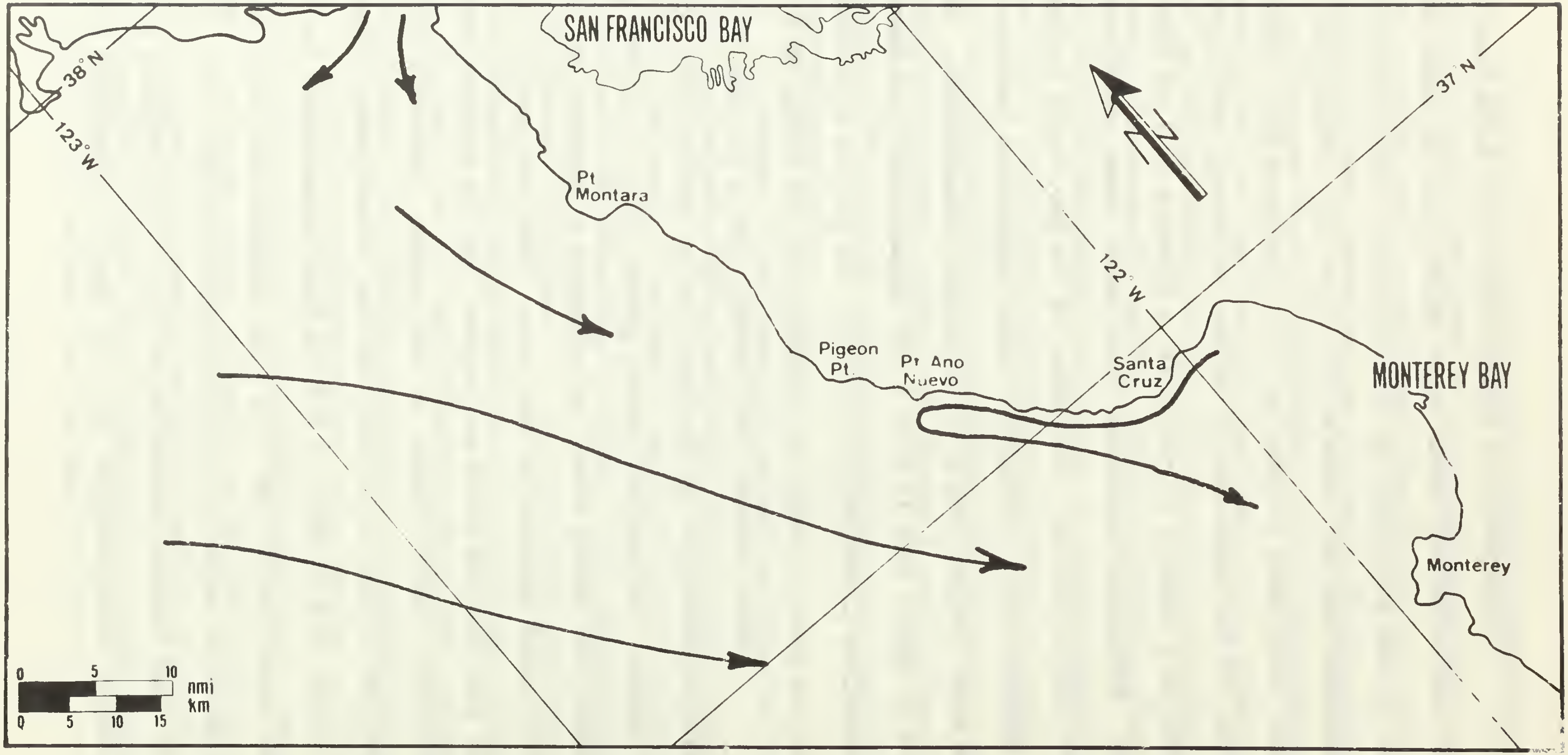
Cross Section 10 (p 112) across the entrance to San Francisco Bay illustrates the effect on transmissivity of particulates coming from the Bay. Low transmittance, with the exception of a 60% band between 10-35 m, is found across the entire entrance. Particle count is also high across the entire section. None of the upwelling effects noticeable in Cross Section 8 are seen.

Cross Section 9 (p 109), which extends southwestward from the northernmost station of Cross Section 10, indicates turbid water located in a 20 nmi wide, 5 m deep, band centered about 0-2 and 0-3. Relatively turbid water extends out to just beyond 0-2, going from about 10 m, near the shore, to the surface at 0-2. Clear water begins to intrude at 0-2, in a band from 15 m to 70 m, to P-1, which is located 5 nmi off the coast, at 25 m. A protrusion in the 9.5°C and above isotherms, between 0-2 and 0-3, indicates upwelling. These stations are to the northwest of the center of intense upwelling in Cross Section 8. These facts, combined with particulate maxima occurring at 0-2, imply that this is probably the northernmost extent of the upwelling pattern. As in Cross Section 8, the isotherms for temperatures of 9°C and lower also show a steep rise as they approach the coast from below 100 m.

In summary, turbid water to the west and north of Point Montara, appears to move farther and deeper from the shore than in the waters to the south. The probable causes for this fact are the tidal flow from San Francisco Bay, upwelling, and a concentration of sewage outfalls at Point Montara. It is not possible to evaluate the relative importance of each of these sources from the data obtained, although it appears that the outfalls exhibited the least influence during this period. The upwelling area seems to be bounded by Cross Sections 7, 9, and 10. Upwelling in this region appears to start to the west and south of 0-1 and N-13 at depths below 100 m. The assumption of a southern source is based on the fact that the colder isotherms are found at decreasing depths proceeding from off Monterey Bay to the upwelling region. This is presented in a much clearer form in the parallel cross sections (See for example p 136).

Cross Section 1 across Monterey Bay shows that on the north side of the Bay turbid water extends from the coast out to D-6[2]. There is some uncertainty to this evaluation since transmissivity measurements were not taken at D-2 to D-6 [1]. Below these turbid layers, clear water intrudes to 15 m, where once again turbid water exists. On the south side of the Bay, relatively turbid water was present at a depth of 15 m at D-14, a distance of 3 nmi from the coast. Particulate maxima are found within these turbid regions on either side of the Bay. The center of the Bay, which is bisected by the Monterey Canyon, exhibits a rather complicated pattern of relatively clear water ranging from 60 to 80 percent transmissivity. Between D-7 to D-9 at depths from 35 to 65 m the transmissivity was below 60%, with corresponding higher particle counts. The pattern of isotherms suggests either the onset or decay of upwelling over the center of the canyon.

Water movement into Monterey Bay to the east of Cross Section 1 cannot be determined in any detail, for no stations were occupied in that region. One possible current pattern (Fig. 7) is that a counterclockwise flow exists around the perimeter of Monterey Bay, which passes Santa Cruz and continues to Ano Nuevo. This flow possibly joins the normal flow from the north and returns into the northern section of Monterey Bay, thereby forming an eddy system. The basis for the above supposition is that at D-1 very low beam transmittance occurred from the surface to 8 m, while at H-8 the beam transmittance for the same depths ranged from 20-38%. The lower readings near Santa Cruz could more easily be caused by a counterclockwise current, which is affected by the sandy beaches surrounding the Bay, rivers emptying into the Bay, and perhaps sewage outfalls (Fig. 2), than by a nearshore current from



Proposed Current Flow in Near Surface Water

Figure 7

the north which exhibits higher transmissivity than found in the Bay. In addition, the 8 nmi band of relatively turbid water present on the north side of Monterey Bay, when compared to the 3 1/2 nmi band to the southeast of Santa Cruz, implies that the southerly flow continues in that direction toward the center of the Bay instead of following the coastline past Santa Cruz. Finally, a current from Monterey Bay could more easily cause the complex pattern observed at Point Ano Nuevo.

b. Parallel Cross Sections

The characteristics of the near shore waters from the northwest of Point Montara to southwest of Santa Cruz are illustrated by Cross Section 11 (p 122) and Cross Section 5 (p 119). Cross Section 11 is discussed station-by-station from S-2 south to L-9, which is located southwest of Pigeon Point; following this, Cross Section 5 is examined from L-9 southeast to H-8.

Along Cross Section 11, from Point Montara to Pigeon Point, the water is characterized by low transmittance and high particulate count. The patterns for both these parameters are extremely complex. The highest transmissivity is 50%, which appears as a 5-10 m band, between S-2 and M-2, separating the more turbid surface and bottom affected water. The particulate counts at S-2, which is located directly in the path of San Francisco Bay tidal flow and is possibly influenced by the larger outfalls, are four to five times higher than the counts at the stations to the south. Transmittance isopleths of 10-20% occur in the same area. Another particulate high, of a lesser degree, occurs at M-1. It is supported by low transmittance readings. A possible explanation for this occurrence is the fact it is only 1 1/2 nmi from the coast and may be affected by littoral material. A strong temperature gradient of 1°C/6 m exists around 10 m and shows no effect on containing the particulate structure.

Cross Section 5, from Pigeon Point to Santa Cruz, has a most striking characteristic in that the isopleths of beam transmittance and particulates are elongated and closed. It appears that two different bodies of water are meeting at Point Ano Nuevo, which is located at the distinct rise shown in the bottom contour. Particulate count decreases from L-9 to the southeast, until at I-2 the count increases again. This fact adds credence to the argument that turbid water is coming from Monterey Bay. As in Cross Section 11, the temperature gradient appears to have no affect on particulate maxima.

Cross Section 14 (p 131), Cross Section 15 (p 134), and Cross Section 16 (p 137), extend from the upwelling waters west of Point Montara to the center of Monterey Bay. The beam transmittance isopleths in Cross Section 14 again suggest a meeting of water masses at Point Ano Nuevo. Point Ano Nuevo is located opposite the peak in the bottom contour. A noticeable difference is observed between particulate content in upwelling water and that in the waters south of Point Ano Nuevo. Particulate counts which are found at the surface in the waters to the south are found below 20 m in the upwelling waters, while the upper upwelled water contains noticeably higher numbers of particles. The isotherms display a rise from outside Monterey Bay toward the upwelling area, suggesting the possibility of waters from the south acting as a source for the upwelling.

Cross Section 15 appears to mark the line within which the current from Monterey Bay has turned near Point Ano Nuevo and joined the southerly flow toward the Bay. Here beam transmittance and particulate isopleths show no indication of distinct water masses meeting at Point Ano Nuevo, since they form continuous isopleths across the entire cross section. Beam transmittance increases from the upwelling area to the center of the Monterey Canyon. The isotherm pattern again shows a distinct rise in the upwelling region.

The beam transmittance isopleths in Cross Section 16 suggest that the flow off Point Ano Nuevo is now entirely to the south with a continuous isopleth structure. The isotherm structure for the upwelling area is well represented since the cross section extends to 0-2, which is on the northern boundary of the upwelling region.

Cross Section 12 (p 125) and Cross Section 13 (p 128) enable one to trace the water mass from the center of the San Francisco Bay station line (Cross Section 10) to the stations farthermost off Point Ano Nuevo. Cross Section 12 shows turbid water extending from the mouth of the Bay to between Pigeon Point and Point Ano Nuevo at a distance of 9 nmi from the coastline. This band of water extends to a depth of 15 m until west of Pigeon Point, where it begins to rise toward the surface. Another turbid water mass is found 10 to 20 m above the bottom contour. The correlation of beam transmittance and particle count is good.

Cross Section 13 demonstrates essentially the same features as in Cross Section 12, with the exception of a low transmittance anomoly near the surface at Station J-10.

Cross Section 3 (p 116) is representative of an area relatively unaffected by coastal influences. The broad patterns of beam transmittance and particle count are markedly different from those seen in the cross sections discussed so far.

In summary, parallel cross sections have also indicated the possibility of a current flowing along the coast from Santa Cruz to Point Ano Nuevo. This current probably turns near Point Ano Nuevo and joins the main southerly flow down the coast. Isotherms were consistent with previous presentations of the argument that an upwelling area exists to the west of Point Montara.

3. Comparisons With Past Data

No beam transmittance measurements or particulate counts are available for the study area during the upwelling period. Therefore, the only comparison with previous data that can be made is for temperature. Comparison of the present data with CALCOFI data [Appendix A, Fig. 19] cannot be made, because the latter do not show enough detail in coastal waters.

Temperatures measured in the vicinity of the Kaiser stations were all within 1°C of the May average as presented in the Kaiser report [Appendix A, Fig. 16-18]. Airborne infrared radiation thermometer measurements of surface temperature made by the Tiburon Marine Laboratory on 2 May 1969 and 19 June 1969, provided the best check on temperature contour interpretations as constructed from the cruise data. While details are more obvious in the DE STEIGEUR cruise plots, enough detail is shown in the Triburon data to establish correlation. Absolute temperature values cannot be accurately compared due to the operating characteristics the Barnes IT-2 infrared radiation thermometer. It has a manufacturer's specified accuracy of 0.5°C, but over several hours of operation may experience a calibration shift as much as 4°C under extreme conditions.

On 2 May [Appendix A, Fig. 24], the 11.1°C isotherm northwest of Point Montara indicates a body of water warmer than that west of the Point shown by the 10.6° isotherm. A general warming, from the 11.1°C isotherm southwest of Santa Cruz to the 12.8°C isotherm to the east, is shown. Both of these features are shown in the cruise contours. The contours for 19 June [Appendix A, Fig. 25] show the general warming of the entire area to be expected during this period.

C. CORRELATION OF TEMPERATURE AND BEAM TRANSMITTANCE

The vertical section overlays of beam transmittance and temperature in general show a good correlation; a noticeable exception is for the near shore areas, or within the range of strong coastal effects as the mouth of San Francisco Bay, littoral material, or possibly sewage effluent.

Cross Section 8 (p 106) west of Point Montara illustrates the effects of upwelling in addition to the coastal effects mentioned above. Beam transmittance follows a 1°C/10 m temperature gradient at a depth of 15 to 25 m fairly closely from N-3 to N-9 where upwelling occurs. Near the coastline (N-1 to N-5) where the flow from San Francisco Bay and the sewage outfalls should exert their greatest influence on the water, there is no correlation. In the upwelling area, between N-9 and N-11, low transmissivity isopleths cross below the thermocline about which they had previously been centered.

Cross Section 4 (p 97) southwest of Santa Cruz provides another illustration of non-correlation in near shore waters. A temperature gradient of 1°C/8 m exists from the coast out to H-5, beyond which it weakens considerably with increasing distance from the shore. Between H-7 and the coast transmissivity isopleths cross the thermocline from the surface and proceed to follow the bottom contour. From beyond this point to H-5, the isopleths remain on, or within, the top of the thermocline. Beyond H-5, the beam transmittance becomes high and spreads with the thermocline.

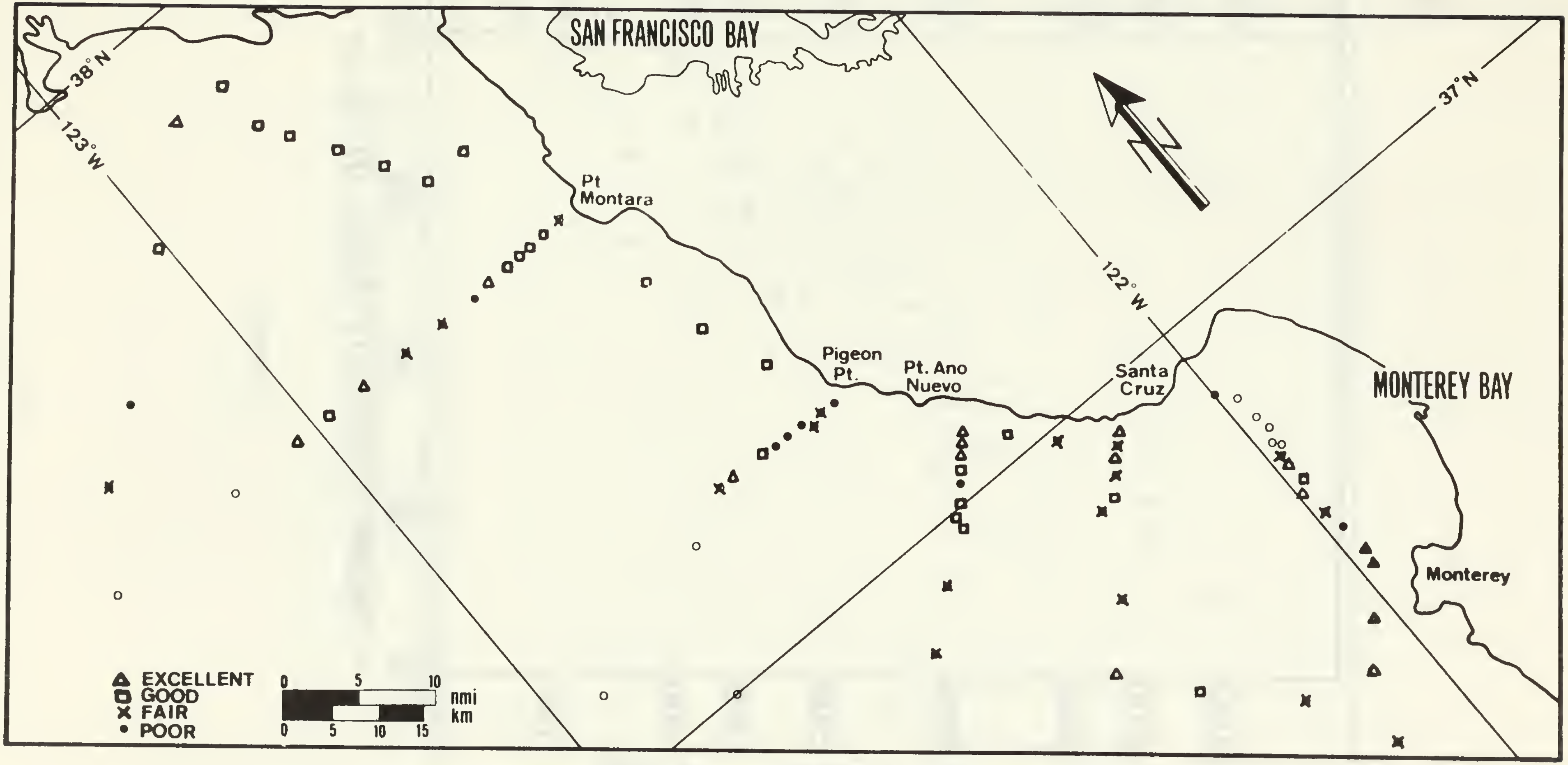
D. CORRELATION OF TEMPERATURE AND PARTICLE COUNTS

A fair correlation of temperature and particle counts could be made in other than near shore waters.

In general temperature gradients of greater than 1°C/10 m appear to contain particulate maxima. In near shore waters the temperature gradients had no effect on the particulate distribution. Cross Section 8 (p 106) west of Point Montara illustrates this case. Here a gradient of 1°C/8 m to 1°C/12 m contains a major part of the particulate structure, except in the upwelling area and very near the coastline, where isopleths of particle count cross isotherms freely.

E. CORRELATION OF BEAM TRANSMITTANCE AND PARTICLE COUNTS

Correlations of beam transmittance and particle counts, based on vertical station profiles in Appendix C, generally appear to be reasonable.Correlations for individual stations ranged from poor to excellent. Figure 8 shows the stations evaluated as to their quality of correlation. "Excellent correlation" is defined as no anomalies appearing in the inverse relationship existing between these quantities. That is, when particulate count increased, beam transmittance decreased and vice versa. "Good correlation" means one reading at a particular depth did not appear to correlate. "Fair" means two anomalies were present and while "poor" indicates three or more. It should be noted that five of the nine stations designated as having poor correlation are to be found in the J and L station lines west of Point Ano Nuevo. Scatter plots of percentage beam transmittance versus total particle count in thousands were made for these catagories [Figs. 9-12]. Beam transmittance values vary from zero to 85 percent. The scatter in Figs. 9 and 10 from the approximately linear relationship suggested in Figs.



Station Beam Transmittance-Particle Count Correlations

Figure 8

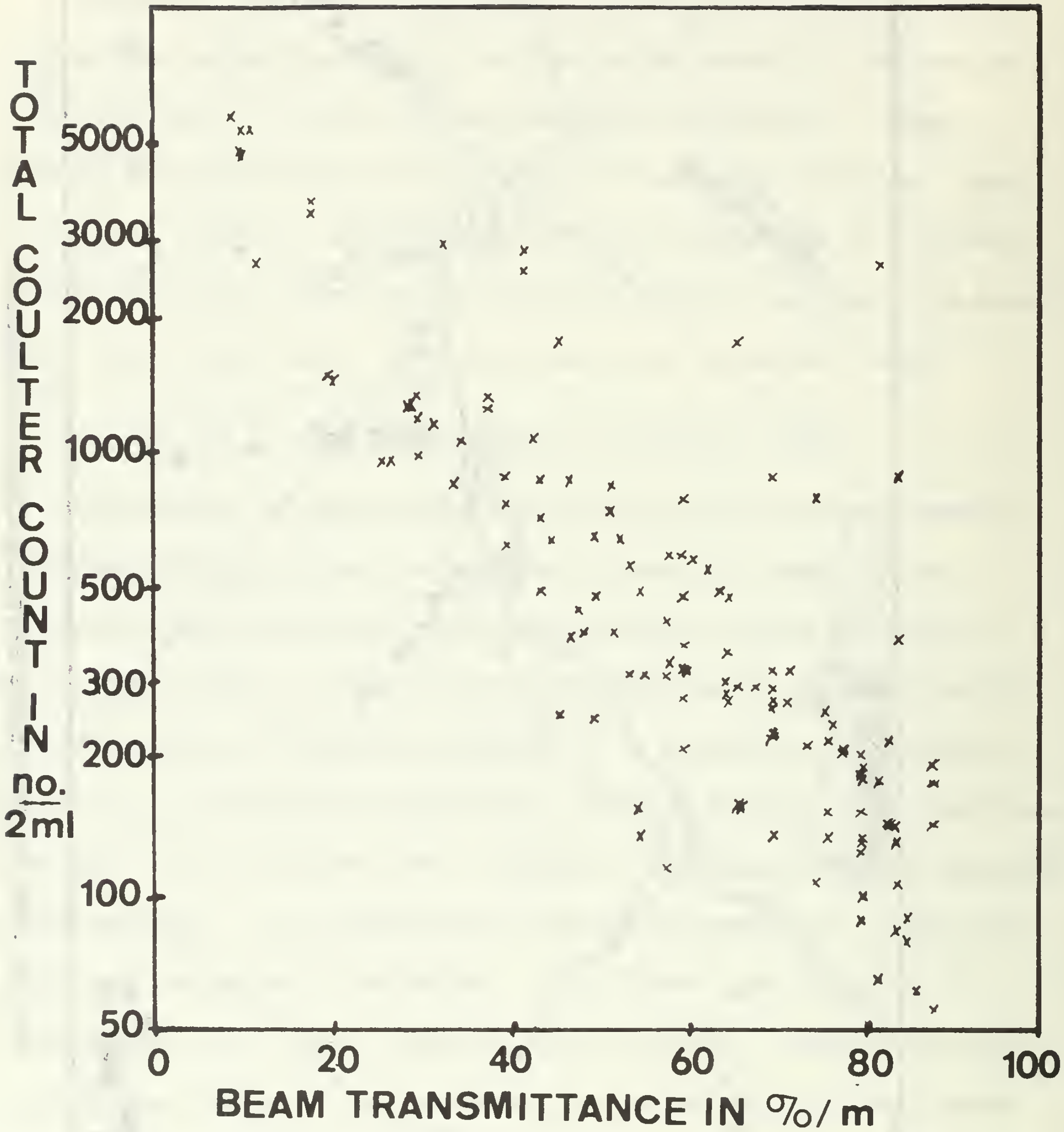

TOTAL COULTER COUNT IN no./2ml
5000
3000
2000
1000
500
300
200
100
50
0
20
40
60
80
100
BEAM TRANSMITTANCE IN %/m

Figure 9

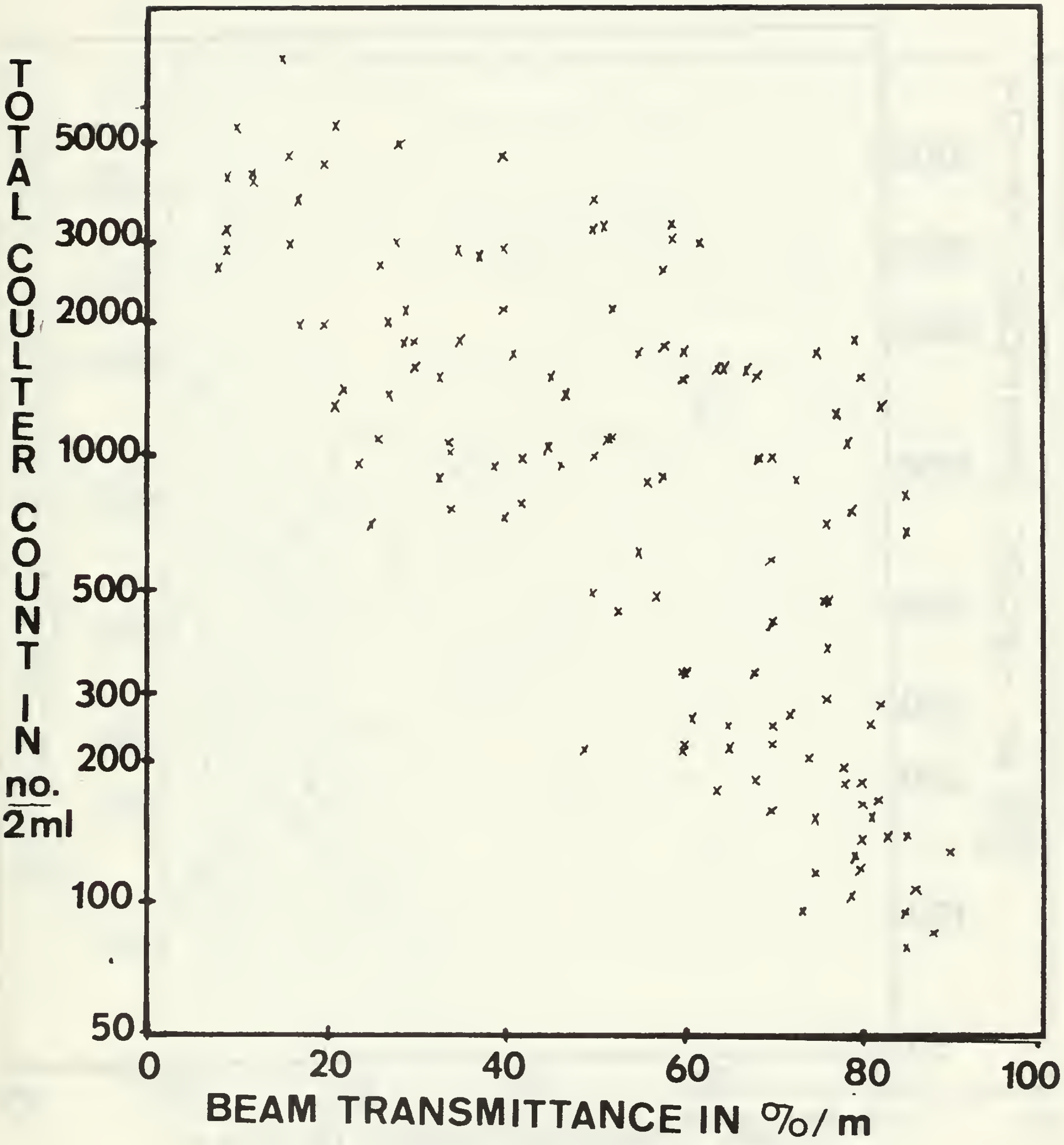

TOTAL COULTER COUNT IN no./2ml
5000
3000
2000
1000
500
300
200
100
50
0
20
40
60
80
100
BEAM TRANSMITTANCE IN %/m

Figure 10

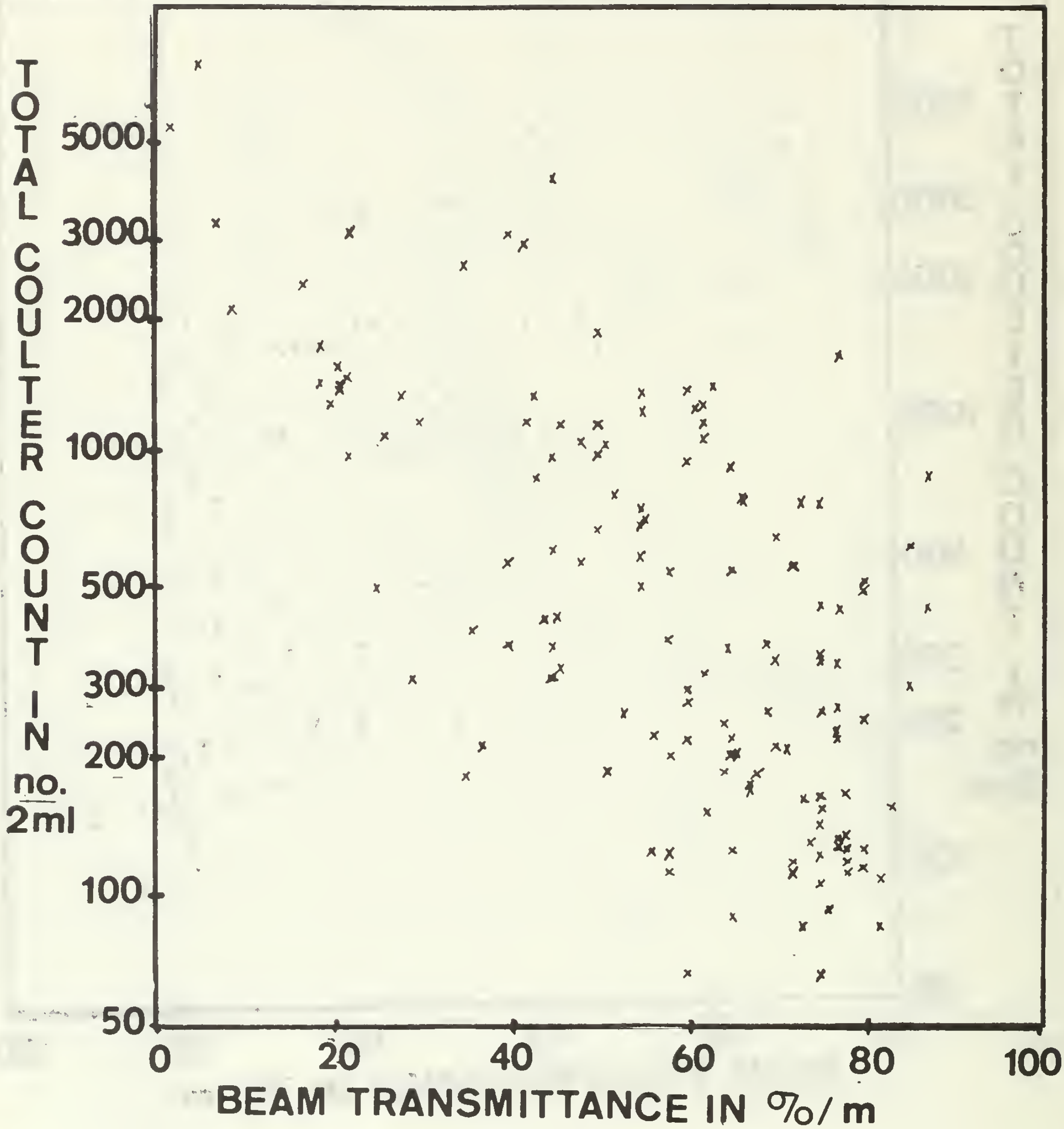

TOTAL COULTER COUNT IN no./2ml
5000
3000
2000
1000
500
300
200
100
50
0
20
40
60
80
100
BEAM TRANSMITTANCE IN %/m

Figure 11

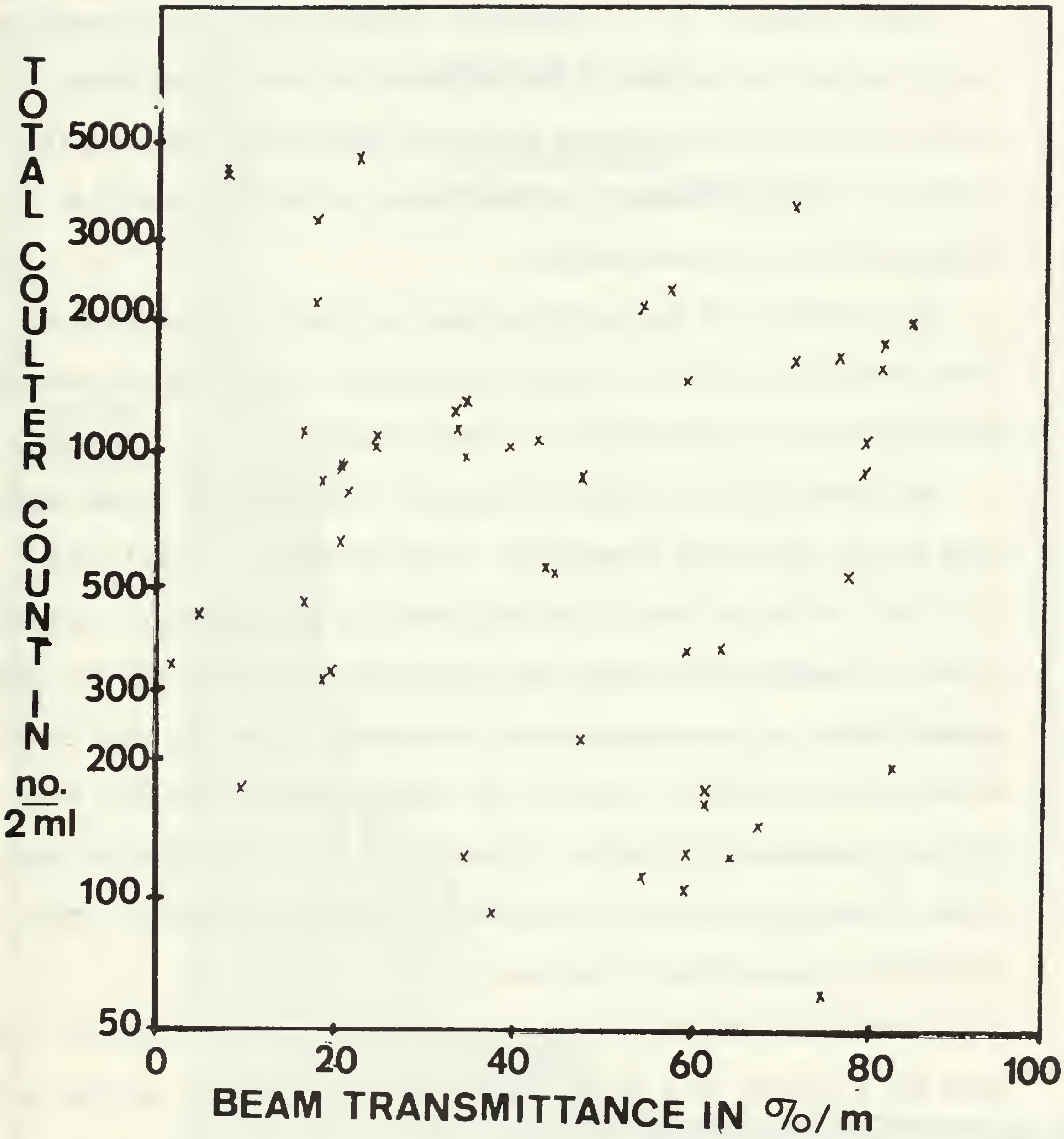

TOTAL COULTER COUNT IN no./2 ml
5000
3000
2000
1000
500
300
200
100
50
0
20
40
60
80
100
BEAM TRANSMITTANCE IN %/m

Figure 12

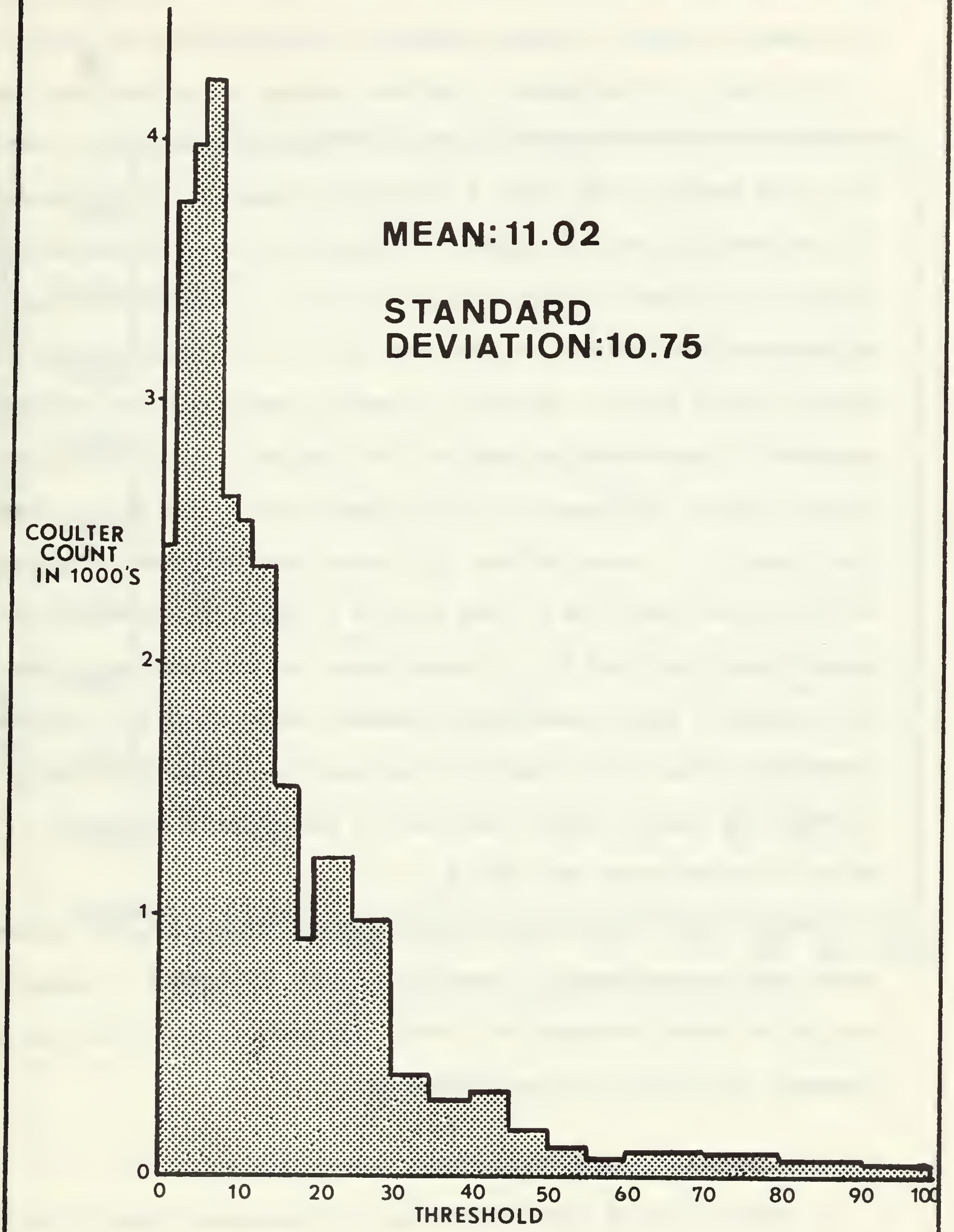
11 and 12, cannot be attributed to any particular location within the study area. There is an absence of the combination of low transmissivity and low particle count, indicating the possible absence of "yellow substance".

Cross Section 4 (p 97) southwest of Santa Cruz is an example of nearly perfect correlation. The isopleths of beam transmittance closely follow the particulate maxima as they extend seaward and along the bottom. The high particle count at H-2 occurs with a corresponding low transmissivity.

The potential of the bottom sampler is clearly illustrated in Cross Section 10 (p 112) across Monterey Bay. Particulate count is the highest of anywhere within the cross section.

The possibility of "yellow substance" being present in the study area is not completely discounted. Cross Sections 7 (p 103) and 8 (p 106), which are west of Pigeon Point and Point Montara, respectively, illustrate that while the particulate structure has the same general shape as the transmissivity structure, there are many cases of isopleths crossing. Thus for the same particulate counts, high and low transmissivity exists. Since these cross sections are near areas of sewage outfalls, the presence of "yellow substance" would seem more probable than otherwise.

A comparison was made between the relative size distribution histogram for a mixture of 6 to 14 μ latex spheres [Fig. 13] and the individual relative-size distribution histograms for the sea water samples. From Fig. 13 it is seen that the threshold settings corresponding to the mean diameter and one standard deviation to the right of the mean diameter are 11.02 μ and 10.75 μ, respectively. An average diameter of 7.22 μ



Relative Coulter Pulse Levels for 6-14 µ Latex Spheres

Figure 13

and standard deviation of 2.37 μ was measured for the latex spheres by Dow Chemical Company, Midland, Michigan. Assuming that the pulse height is essentially proportional to particle volume, use of the known mean diameter, the mean measured during calibration of the Coulter Counter, and the pulse height of the mean, a calibration curve can be constructed to indicate that the particulates corresponding to approximately 95 percent of the total counts are less than 12 μ in diameter, while approximately 60 percent are less than 8.8 μ. Dr. Isabella Abbott of Hopkins Marine Station, Stanford University, Pacific Grove, California, examined 20 representative samples from throughout the area and from various depths, and observed that the particulates were all at least less than 10 μ. Yeske and Waer [21] stated they had found 68 percent of their total counts to be less than 10 μ, while approximately 96 percent were less than 13 μ. These figures are not correct in that they assumed a linear relationship between pulse height and particle diameter, instead of a volumetric relationship. Correcting their figures, the results should read that 68 percent were less than 7.6 μ, while 96 percent were less than 8.5 μ.

Profiles of particulate size distribution histograms for representative stations are shown in Appendix D. They illustrate in general that particulate sizes decreased with depth and that as the bottom was approached, particulate content increased.

F. CORRELATION OF BEAM TRANSMITTANCE AND SOUND VELOCITY

A scatter plot of beam transmittance versus sound velocity is shown in Fig. 14. No correlation was found between the two parameters utilizing this method.

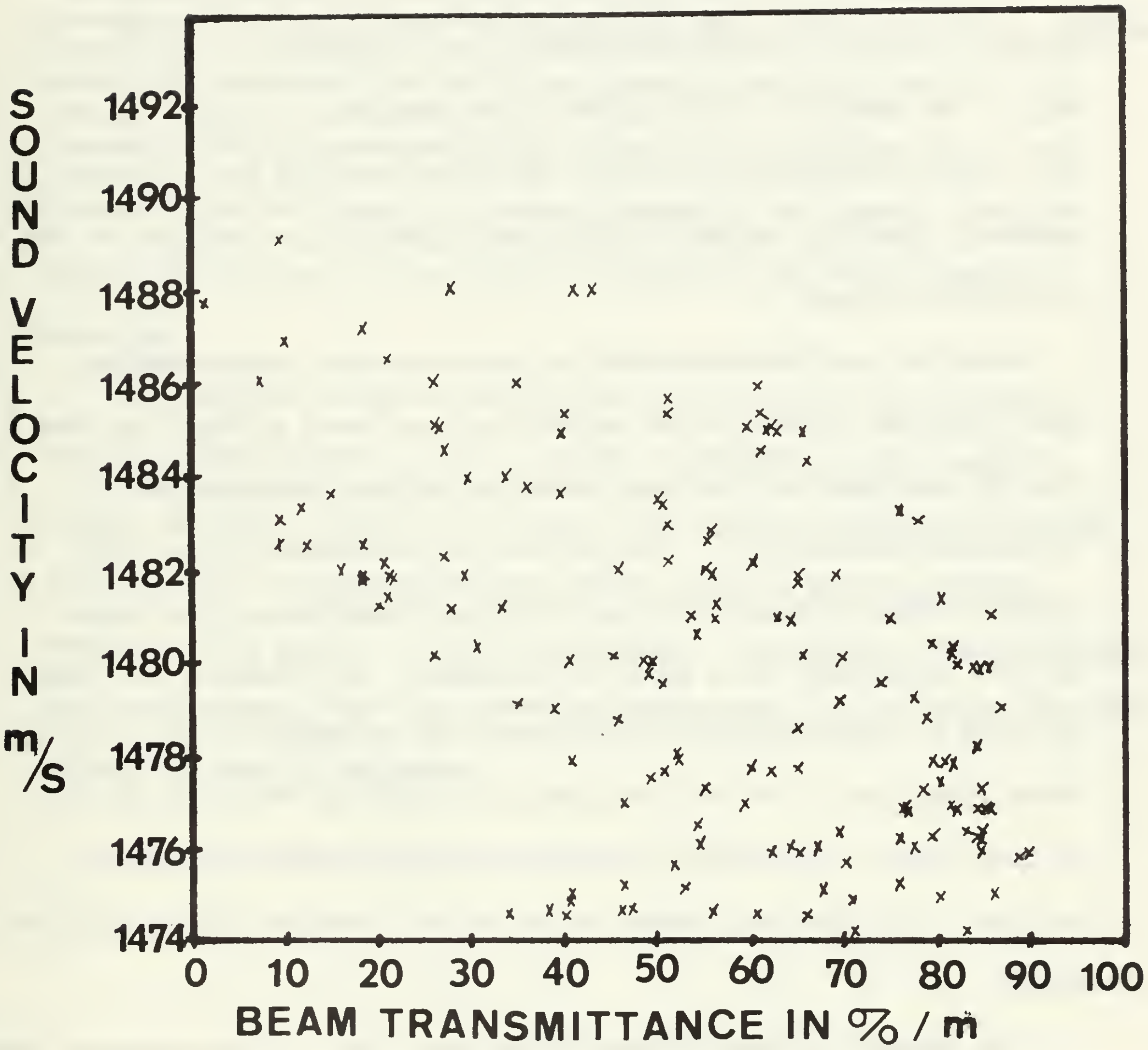

SOUND VELOCITY IN m/s
1492
1490
1488
1486
1484
1482
1480
1478
1476
1474
0
10
20
30
40
50
60
70
80
90
100
BEAM TRANSMITTANCE IN % / m

Figure 14

V. CONCLUSIONS

The complexity of the optical properties of coastal waters in general is known, and the area between San Francisco and Monterey Bays is no exception. The optical characteristics of these waters are normally affected by the flow from San Francisco Bay, littoral material, possibly sewage outfalls, and upwelling in addition to the California Current.

Water of low transmissivity and high particle count extended over a greater volume in the region north and west of Point Montara than to the south of this area where the volume decreased as it approached Monterey Bay. This pattern is complicated by an eddy system located between Point Ano Nuevo and Santa Cruz. The depth of this system may be as great as 20 meters. The cause of the eddy could be a counterclockwise flow around the perimeter of Monterey Bay which flows out of the Bay and along the coast to Point Ano Neuvo. At this point it turns and joins the southerly flowing California Current. This eddy may extend to as far as 5 nautical miles from the coast.

The majority of particulate maxima were found to be associated with temperature gradients of the order of 0.1°C/m, except in near shore areas and in upwelling water. Particulate distribution in waters near the coast were dominated by influences which could have possibly been tidal flow, sewage effluent, and littoral material. A fairly good correlation between beam transmittance and temperature was observed except in near shore areas.

Beam transmittance and particulate matter correlated rather well for many stations. For nine of the 87 stations, however, there was no evident correlation. In general a roughly linear relationship between beam transmittance and log particulate count was found. Approximately 60 percent of the particles observed were less than 8.8 μ in diameter, while approximately 90 percent were less than 12 μ. Particulate size was found to decrease generally with depth. Near the bottom an increase in the number of particles per unit volume was observed.

The proposal, based on the Kaiser report, of the San Francisco Bay-Delta Water Quality Control Board to establish major oceanic sewage outfalls, capable of a flow of 662 million gallons per day by 1990, should be reconsidered only after further, more extensive, studies of the present type are conducted. The optical characteristics vary considerably from the few measurements made at the Kaiser stations during two days in September.

VI. SUGGESTION FOR FURTHER RESEARCH

The continuation of detailed surveys of the coastal waters between San Francisco and Monterey Bays, throughout all the seasons of the California Current System, is strongly recommended.

Stations within Monterey Bay should be occupied to determine the actual influence of northern waters within the Bay.

To better correlate the optical properties of this region, dissolved oxygen, phosphate, and nitrogen measurements, together with biological samples should be taken.

The use of an electrically triggered, multiple bottle water sampler could be used to collect particulate samples. This would allow samples to be obtained when beam transmittance readings of special interest occur. It would also ensure that samples are from nearly the same depth and at the same time as the beam transmittance measurements.

The study of the near bottom particulate profile in the Monterey Bay region still remains to be made, but the bottom water assembly mentioned appears promising. The assembly should be lengthened to gain a longer and better profile.

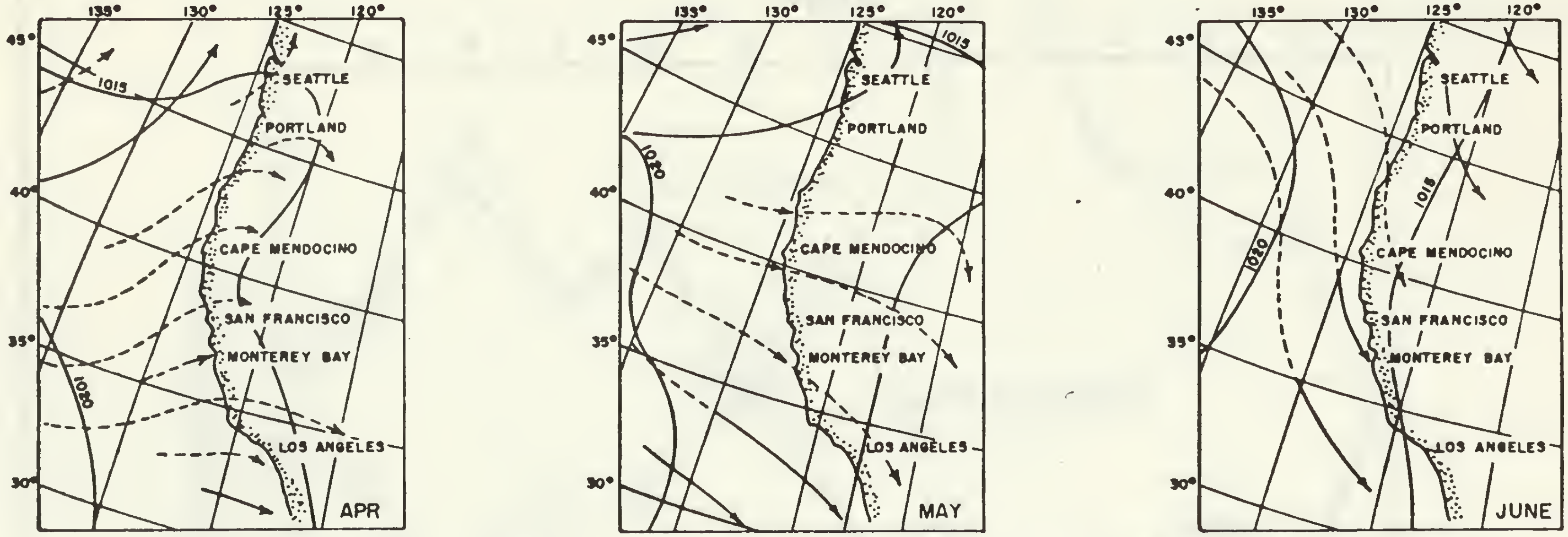
Current meters, drift bottles, or even drift cards could be used to advantage during additional surveys. Current measurements at various depths are definitely needed between Point Ano Nuevo and Santa Cruz.

Airborne radiation thermometer flights from the Naval Air Facility, Monterey, California, should be utilized during future cruises to survey not only the waters being covered by the ship but adjacent areas as well.

The beam transmittance meter should be adapted with a filter assembly which would permit in situ filter changes. This would facilitate determination of the possible presence of "yellow substance" in the coastal waters studied.

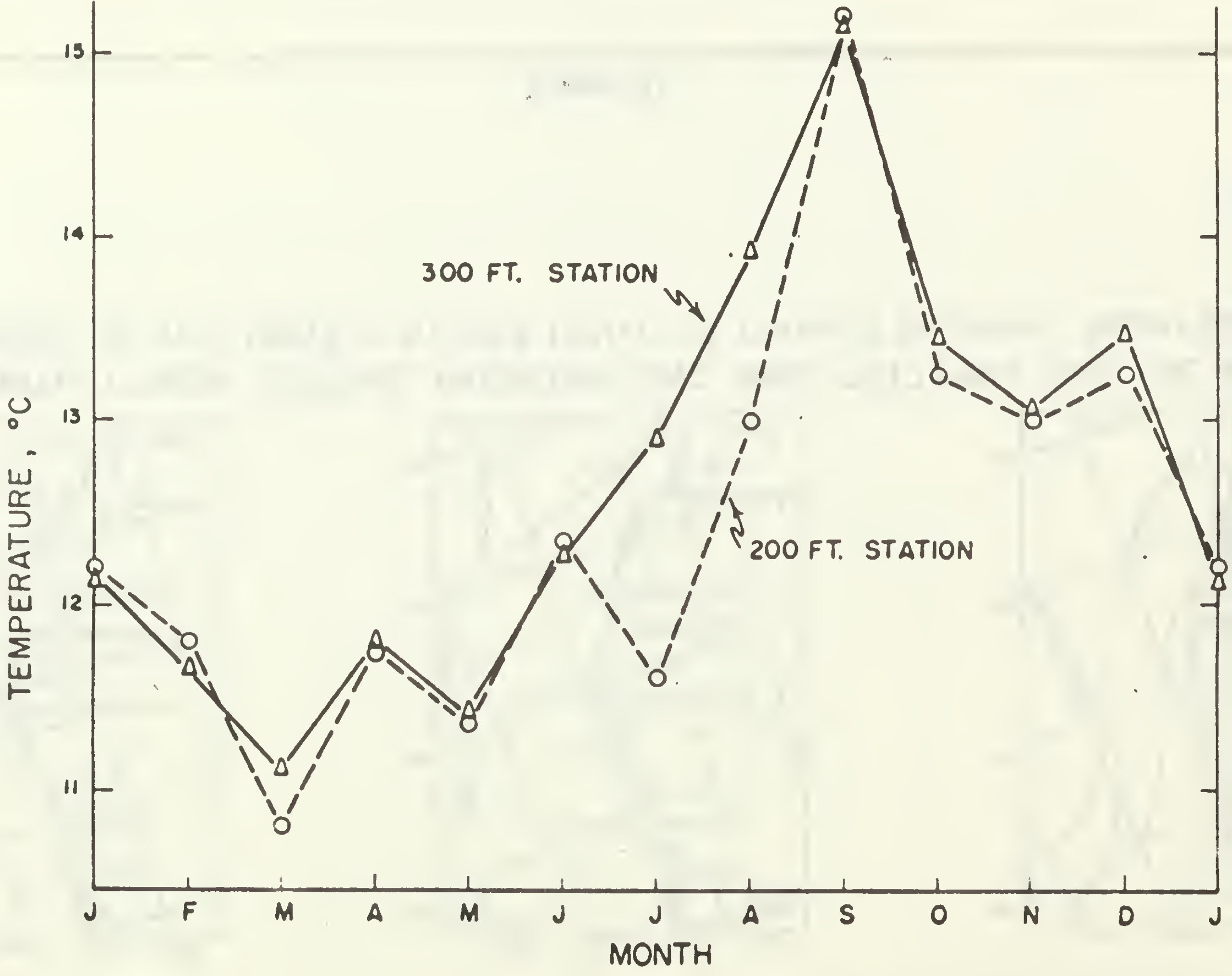
APPENDIX A

DATA FOR SURVEY AREA OBTAINED FROM OTHER SOURCES

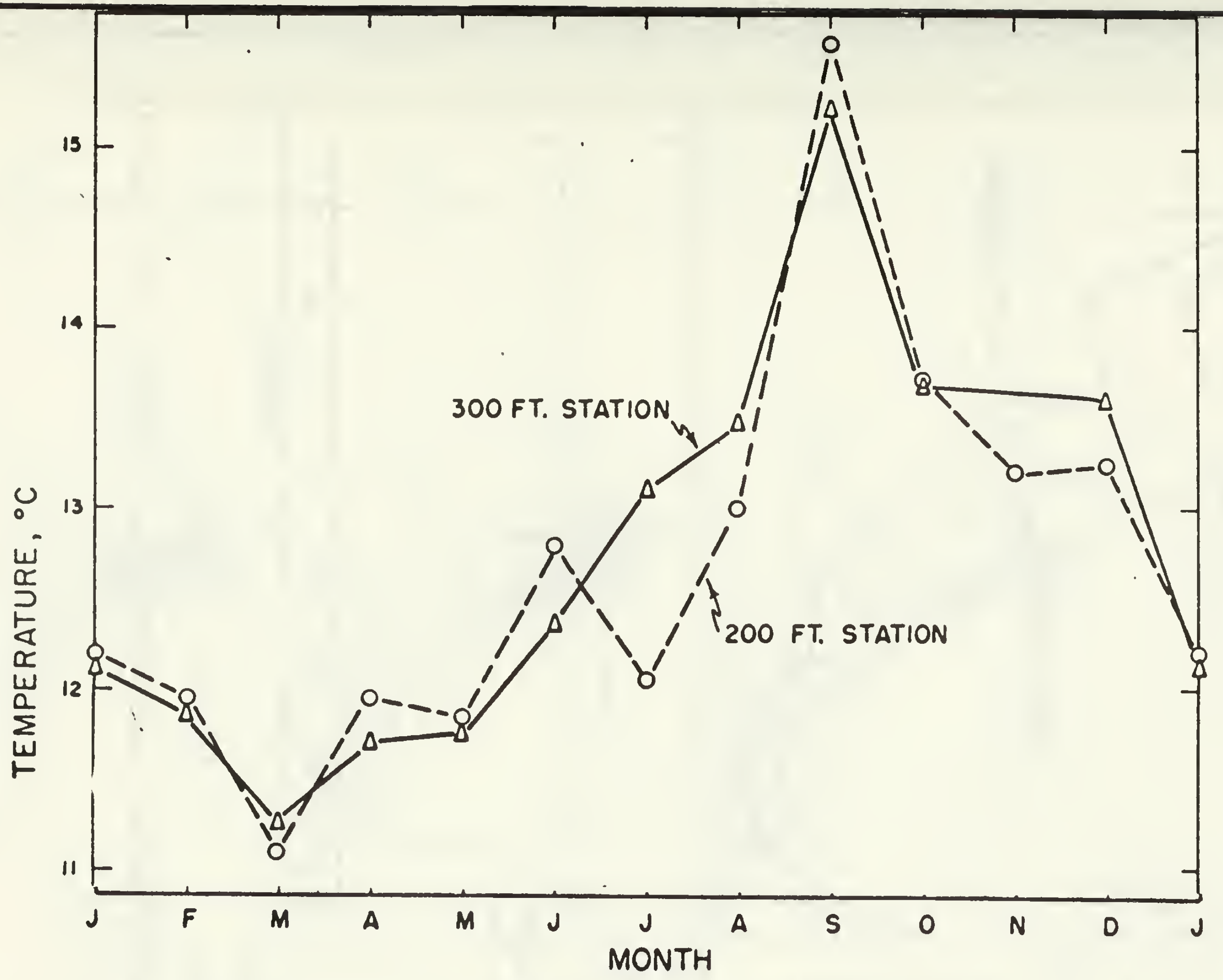


MONTHLY MEAN SURFACE PRESSURE AND WIND PATTERNS OFF THE WEST COAST OF THE UNITED STATES (After U.S. Corps of Engineers' Report No. 2-136)

Figure 15

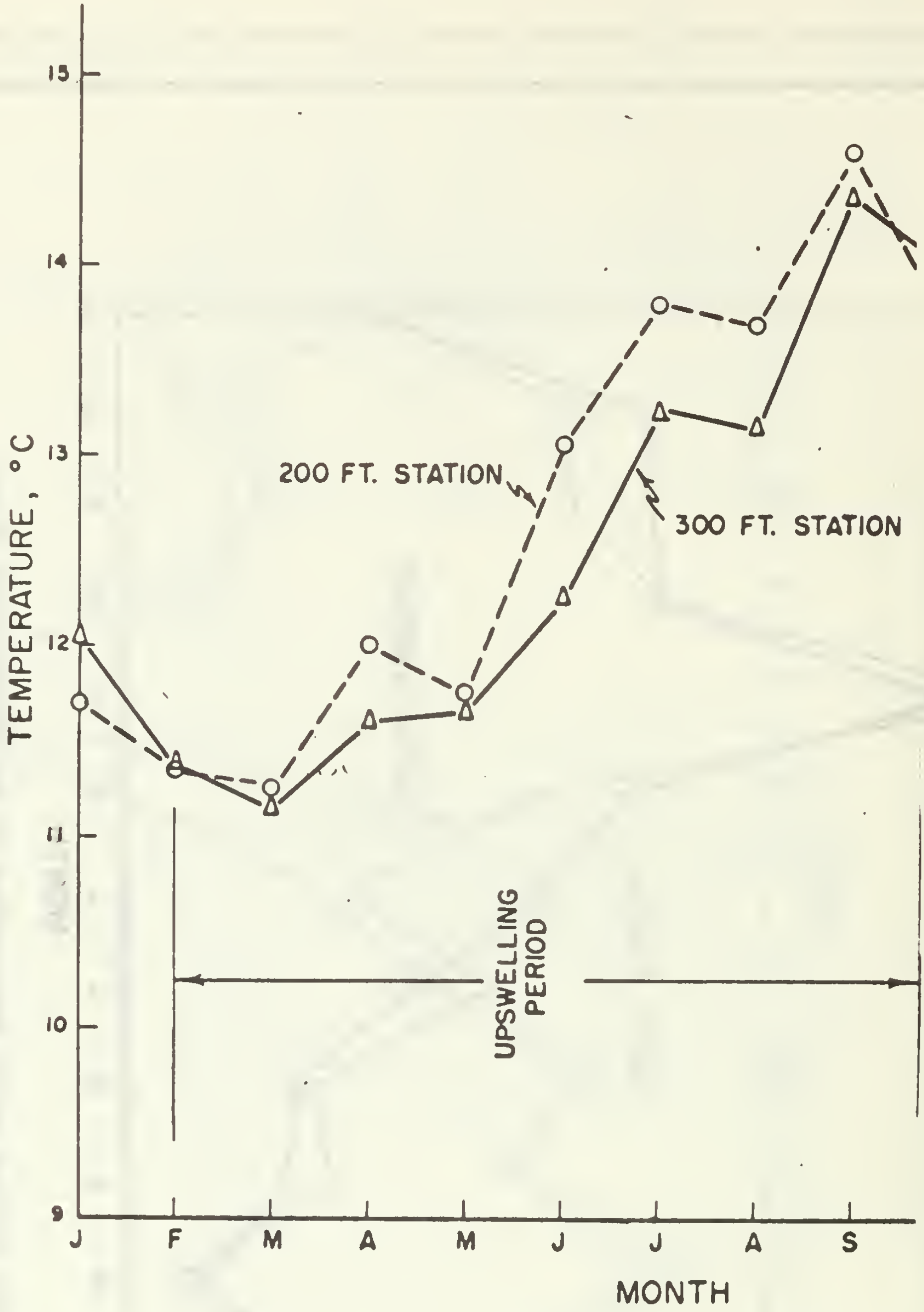


Average surface water temperature at Pillar Point Study Site
Figure 16



Average surface water temperature at Ano Nuevo study site

Figure 17



Average surface water temperature at Sandhill Bluff study site

Figure 18

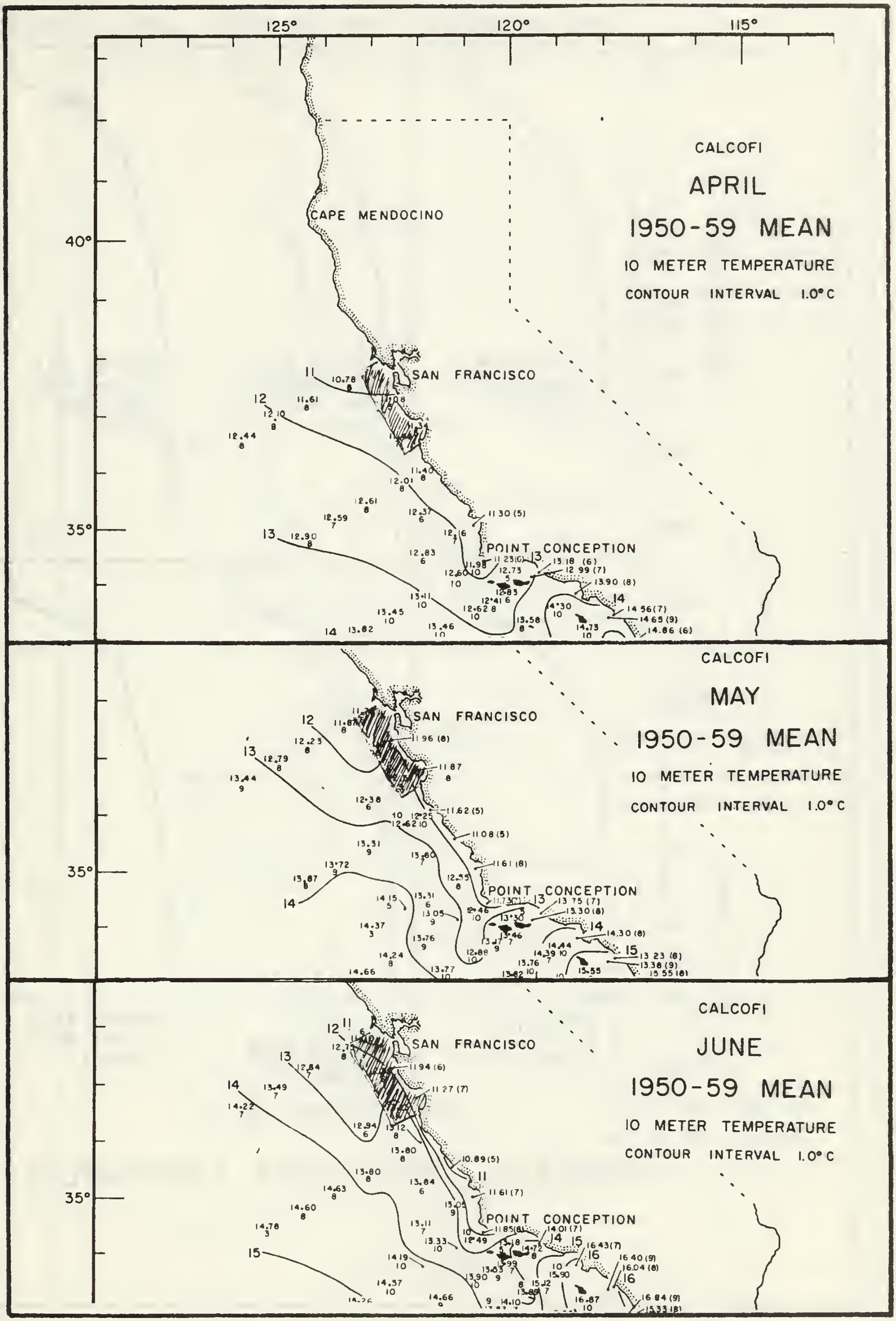
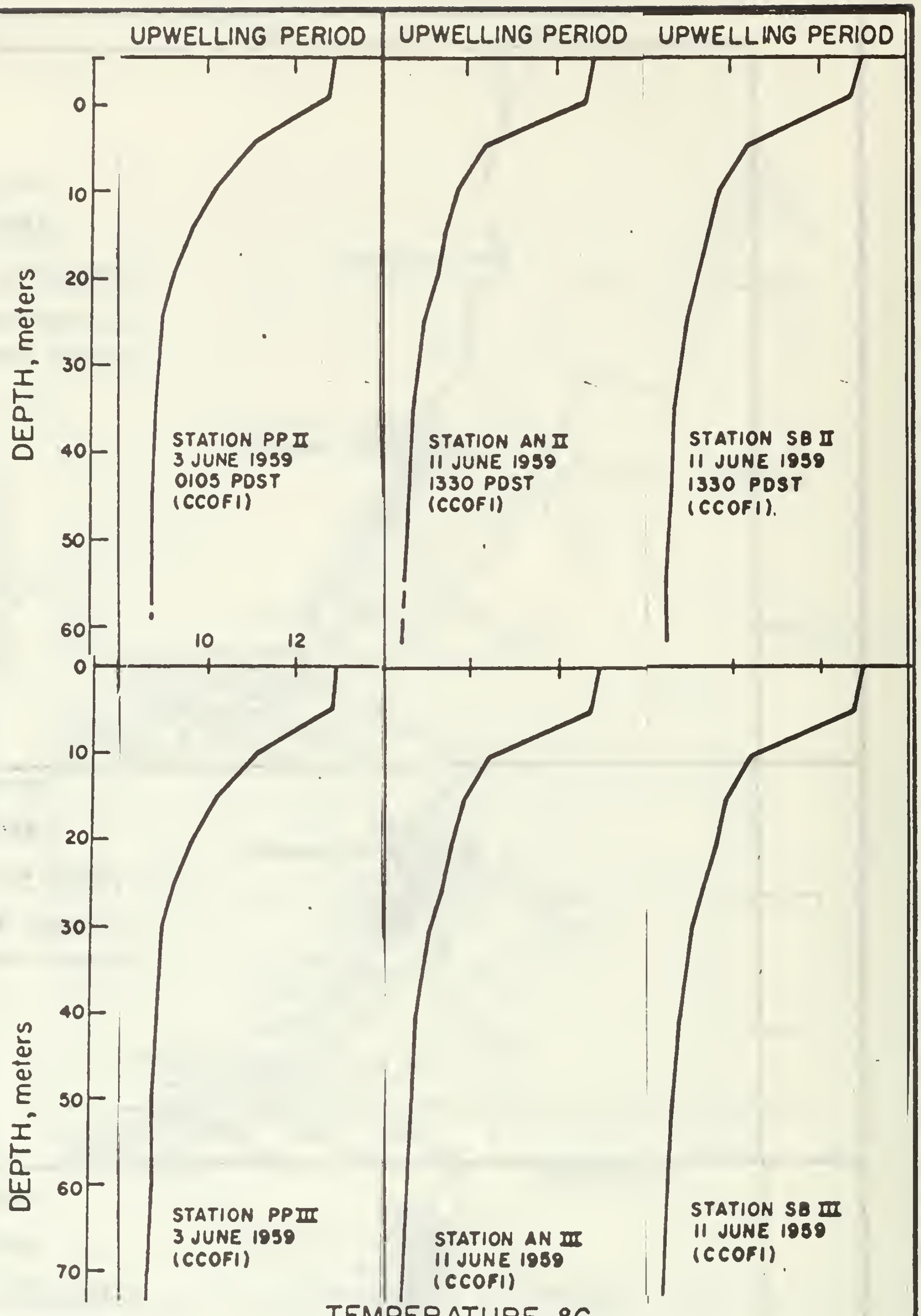

125°
120°
115°
40°
35°
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
CALCOFI
APRIL
1950-59 MEAN
10 METER TEMPERATURE
CONTOUR INTERVAL 1.0°C
11
12
13
14
CALCOFI
MAY
1950-59 MEAN
10 METER TEMPERATURE
CONTOUR INTERVAL 1.0°C
12
13
14
15
CALCOFI
JUNE
1950-59 MEAN
10 METER TEMPERATURE
CONTOUR INTERVAL 1.0°C
11
12
13
14
15
16

Figure 19



PROFILE OF OCEAN WATER TEMPERATURE

Figure 20

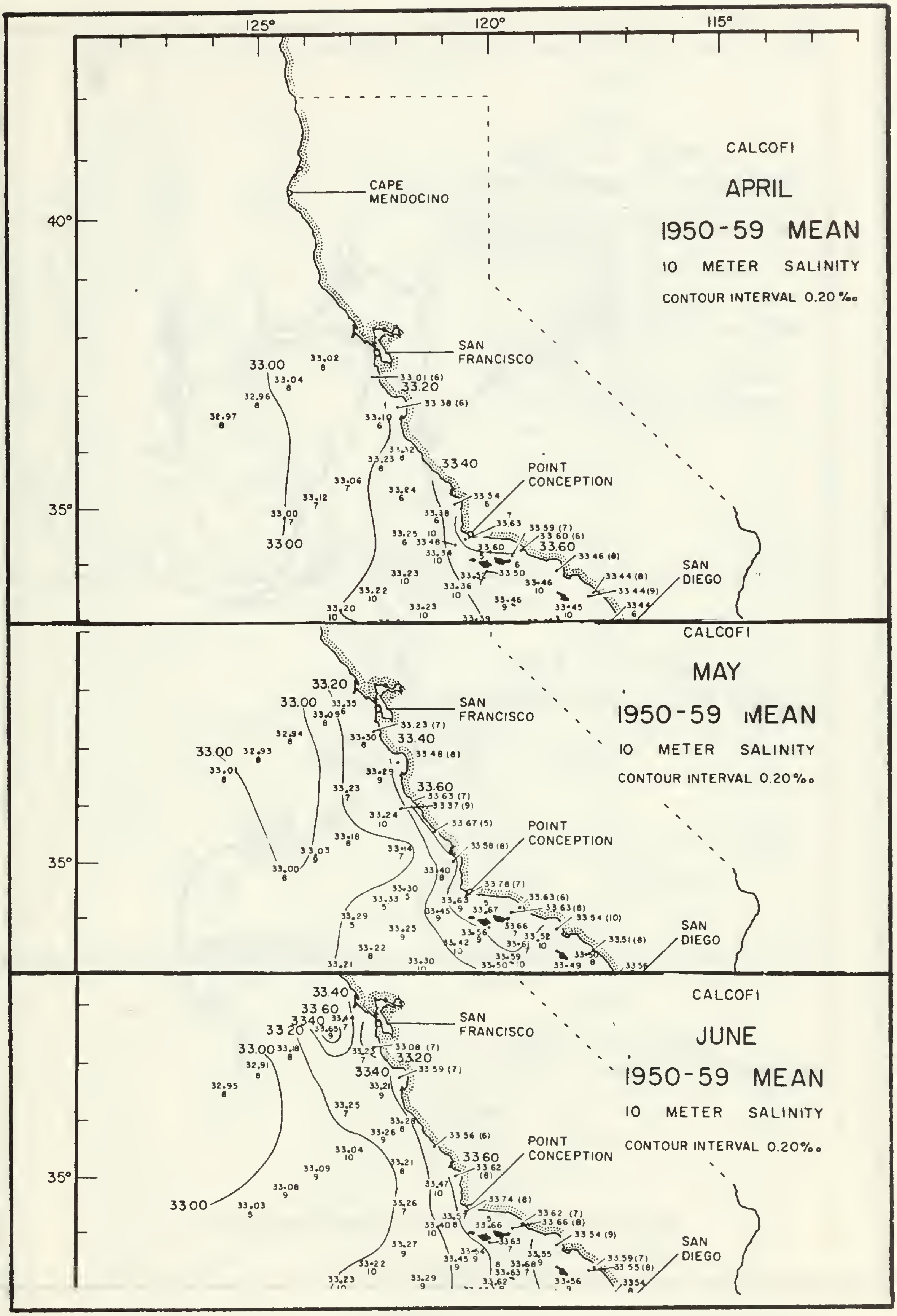
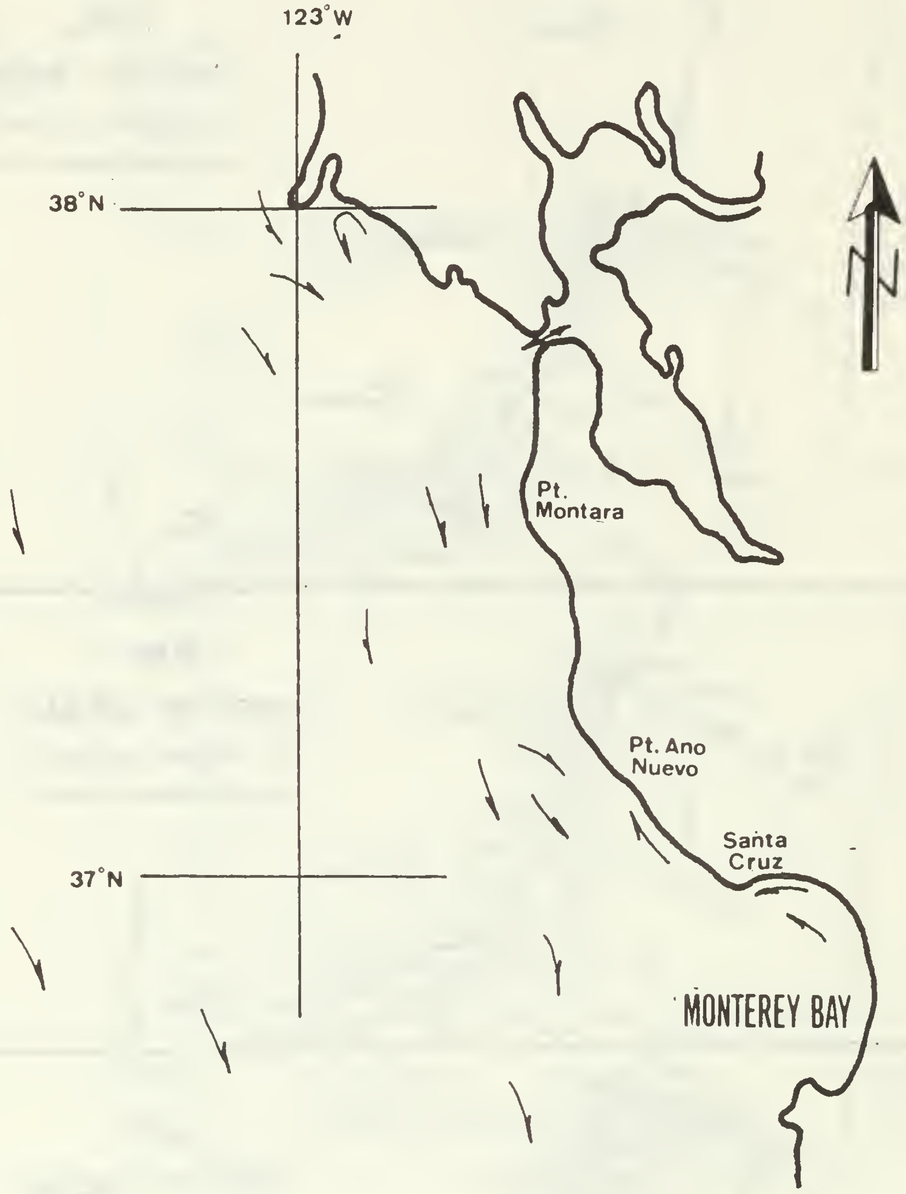
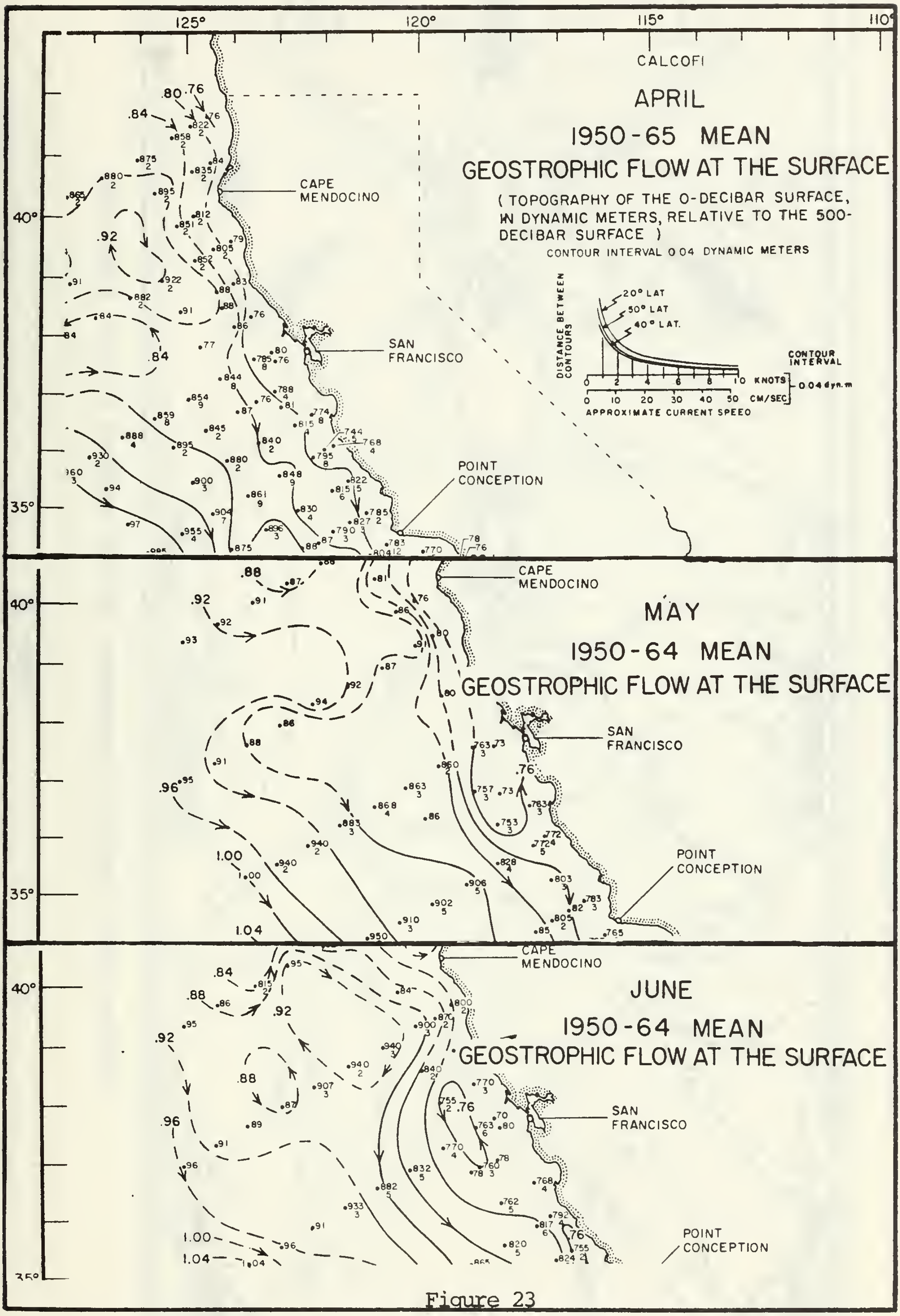

125°
120°
115°
40°
35°
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
CALCOFI
APRIL
1950-59 MEAN
10 METER SALINITY
CONTOUR INTERVAL 0.20 ‰
CALCOFI
MAY
1950-59 MEAN
10 METER SALINITY
CONTOUR INTERVAL 0.20‰
CALCOFI
JUNE
1950-59 MEAN
10 METER SALINITY
CONTOUR INTERVAL 0.20‰
33.00
33.20
33.40
33.60

Figure 21



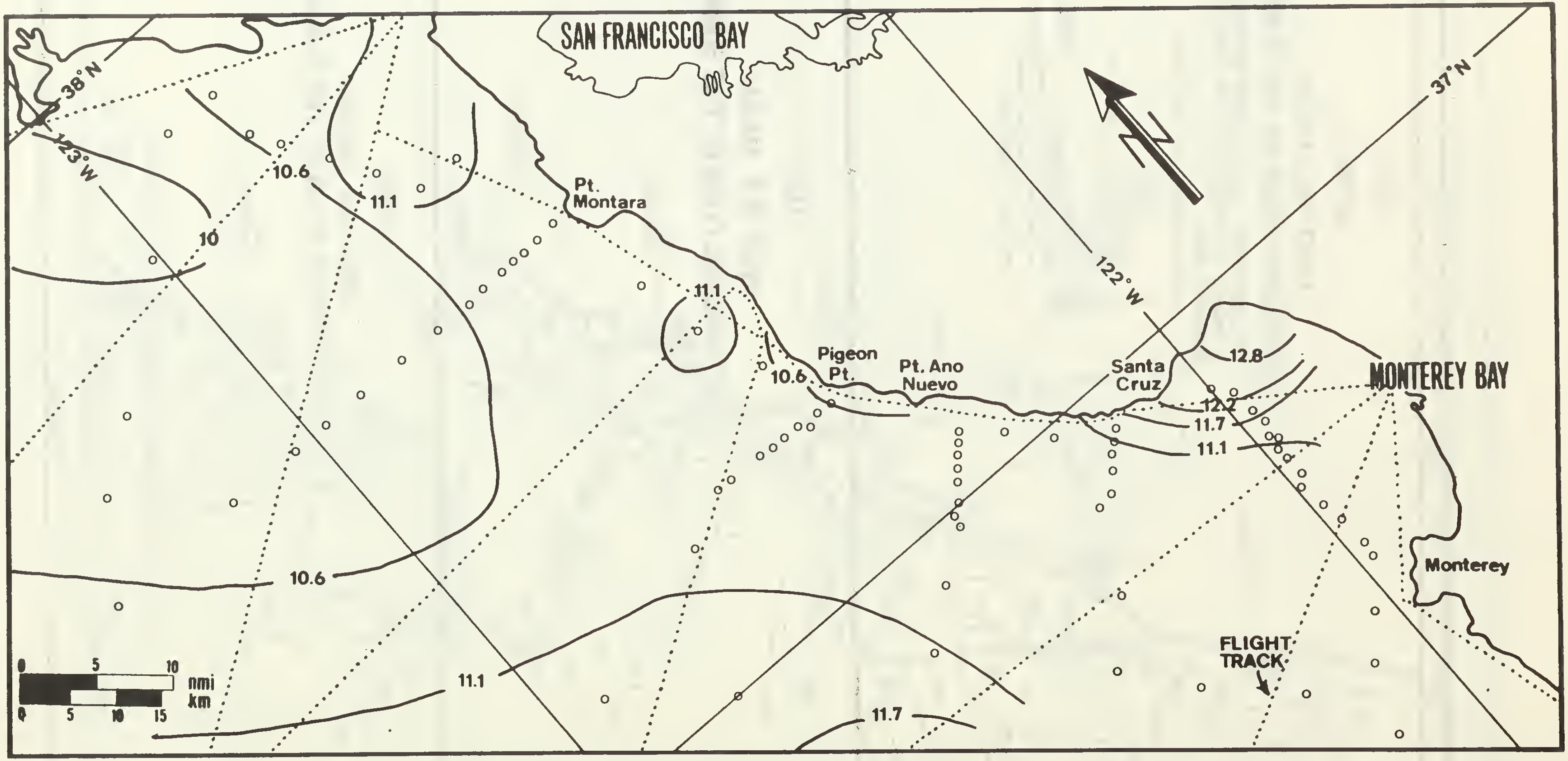
Surface currents during upwelling period

Figure 22



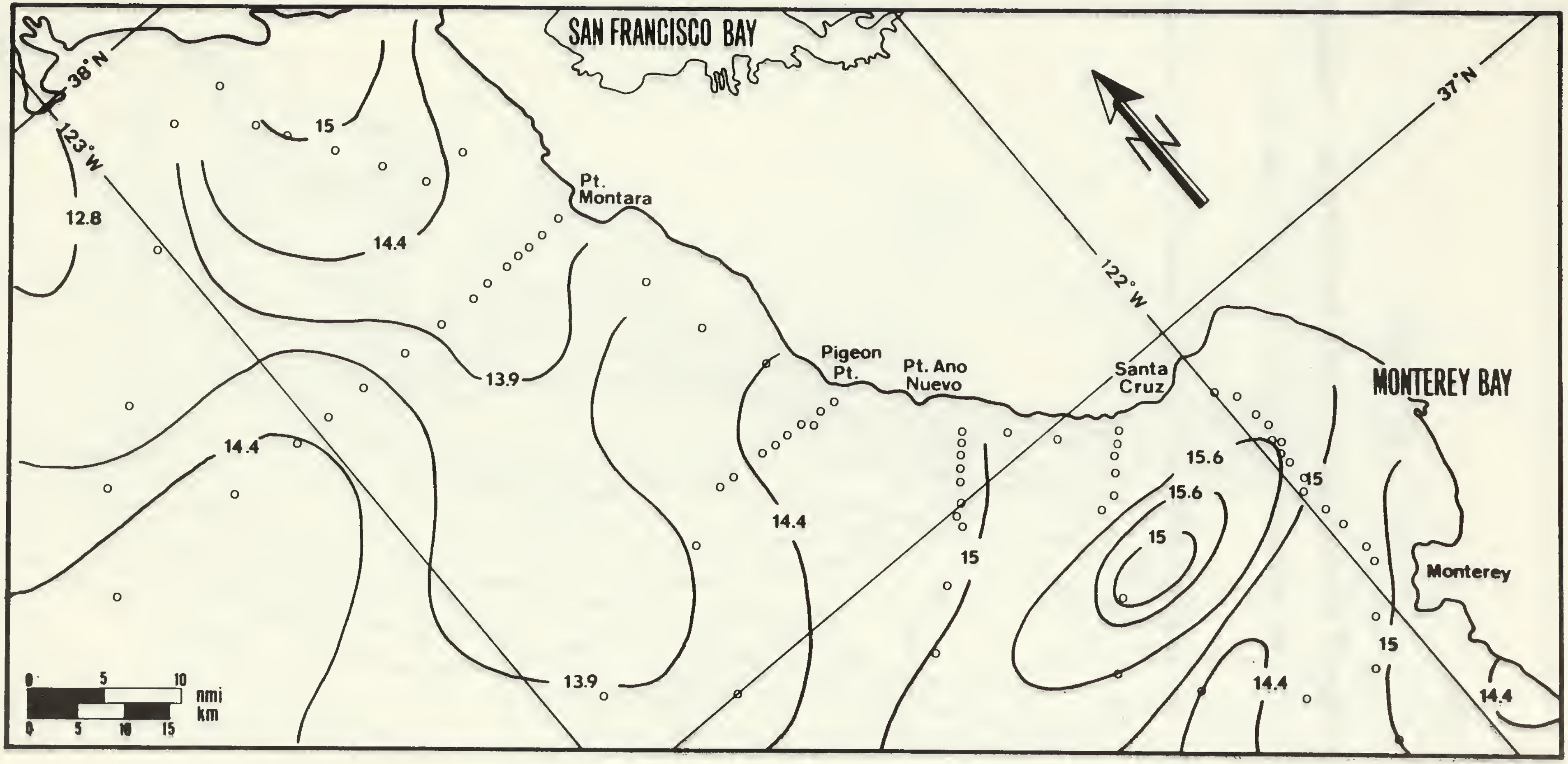
125°
120°
115°
110°
40°
35°
CALCOFI
APRIL
1950-65 MEAN
GEOSTROPHIC FLOW AT THE SURFACE
(TOPOGRAPHY OF THE 0-DECIBAR SURFACE, IN DYNAMIC METERS, RELATIVE TO THE 500-DECIBAR SURFACE)
CONTOUR INTERVAL 0.04 DYNAMIC METERS
DISTANCE BETWEEN CONTOURS
20° LAT
30° LAT
40° LAT.
0 2 4 6 8 10 KNOTS
0 10 20 30 40 50 CM/SEC
APPROXIMATE CURRENT SPEED
CONTOUR INTERVAL
0.04 dyn.m
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
.80
.76
.84
.92
.84
MAY
1950-64 MEAN
GEOSTROPHIC FLOW AT THE SURFACE
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
.88
.92
.96
1.00
1.04
.76
JUNE
1950-64 MEAN
GEOSTROPHIC FLOW AT THE SURFACE
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
.84
.88
.92
.88
.96
1.00
1.04
.76

Figure 23



Airborne infared radiation thermometer surface contours (°C) for 2 May 1969

Figure 24



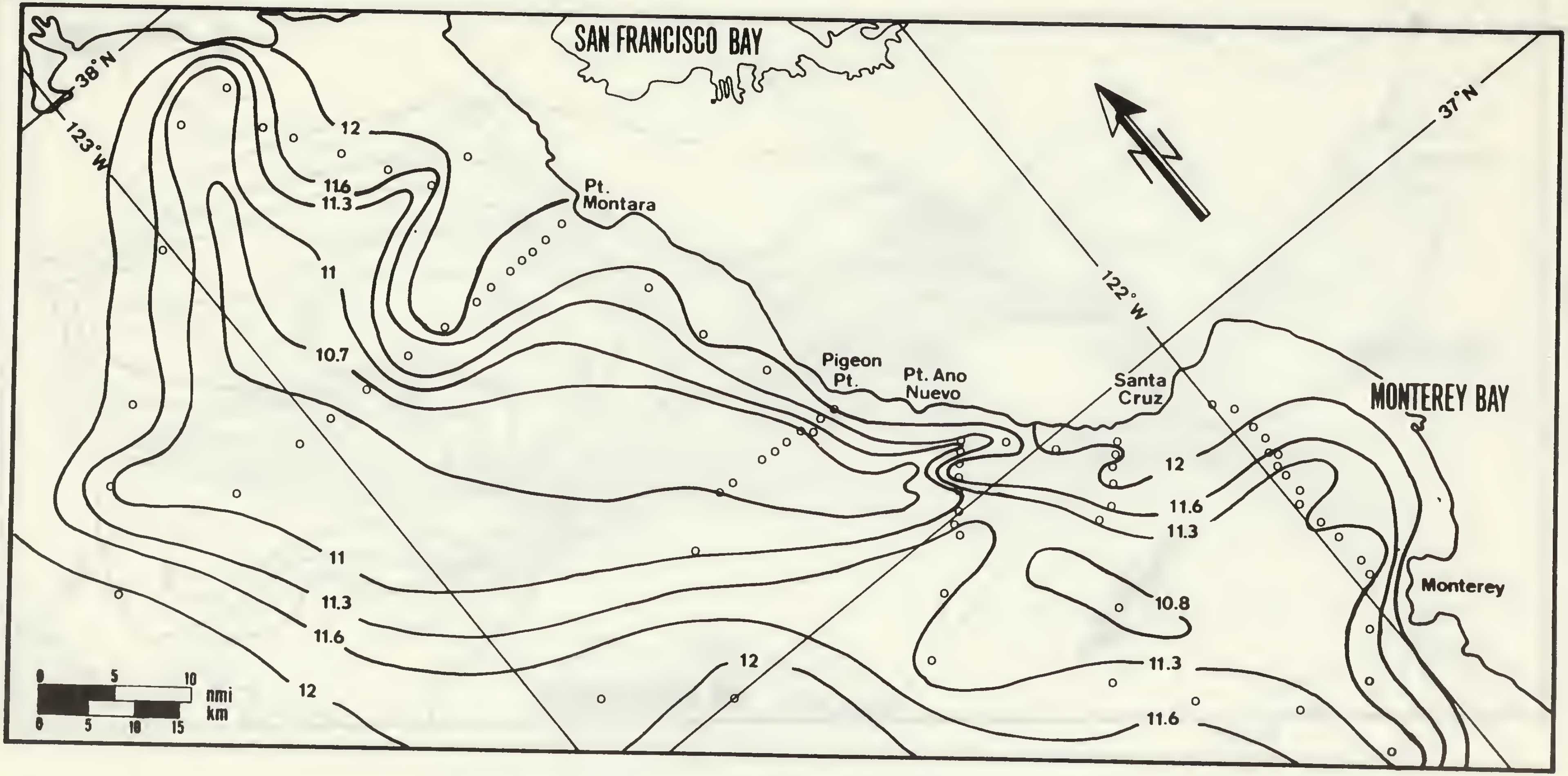
Airborne infared radiation thermometer surface contours (°C) for 19 June 1969

Figure 25

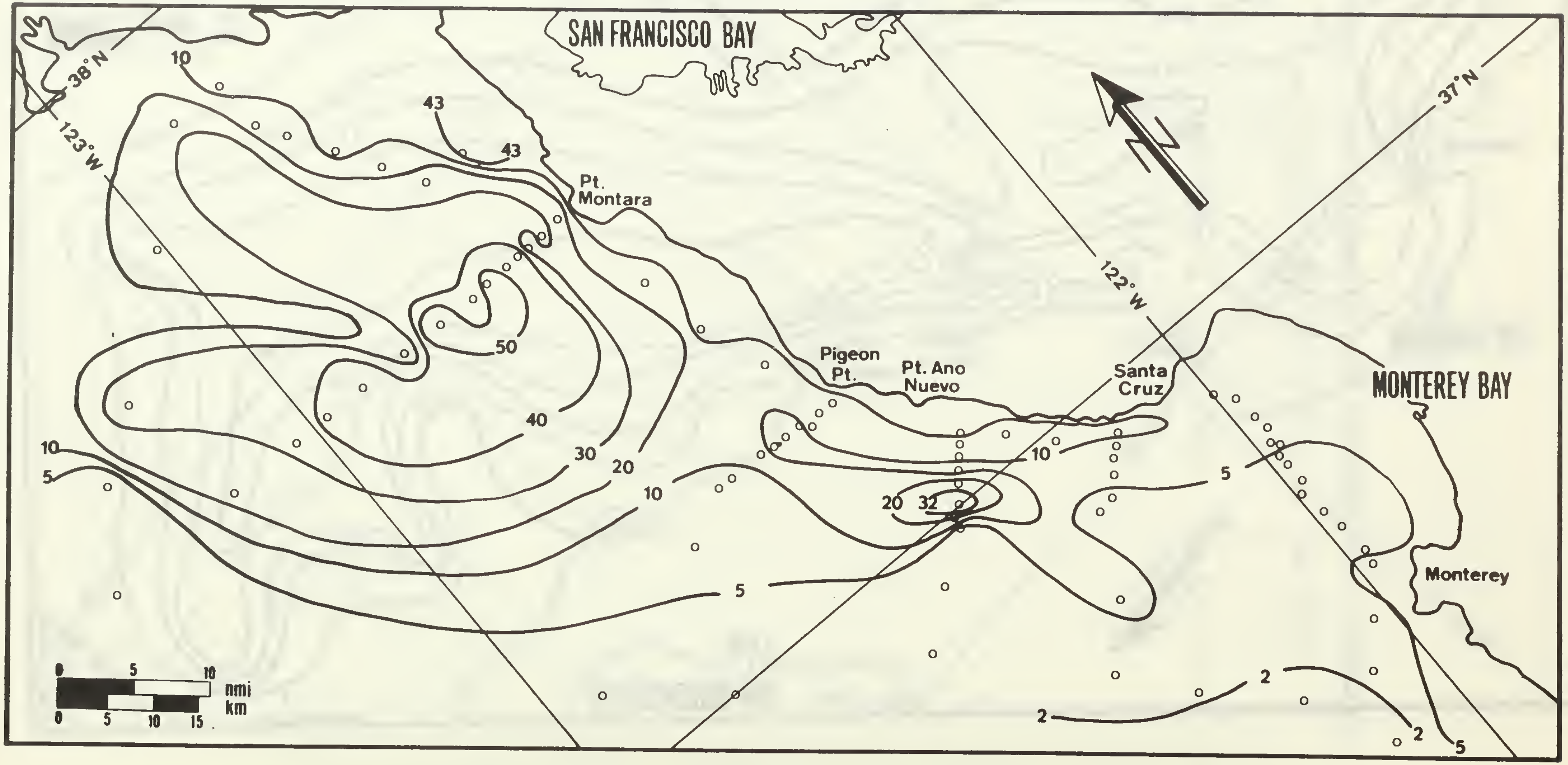
APPENDIX B

HORIZONTAL CONTOUR CHARTS OF BEAM TRANSMITTANCE, TEMPERATURE AND COULTER COUNT AT 0, 10, 20, 40, AND 61 M

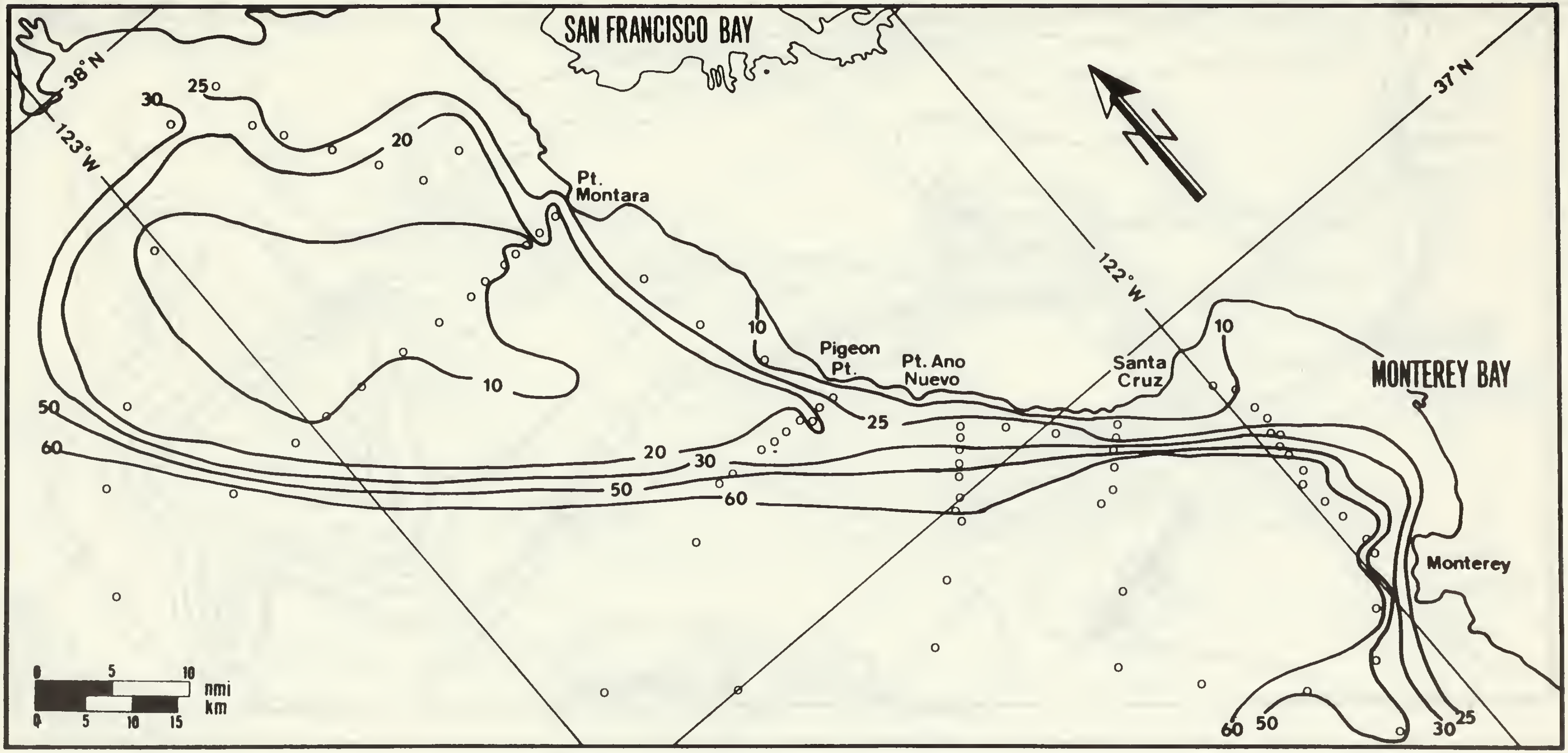
NOTE: In this APPENDIX the contour intervals are not strictly constant.



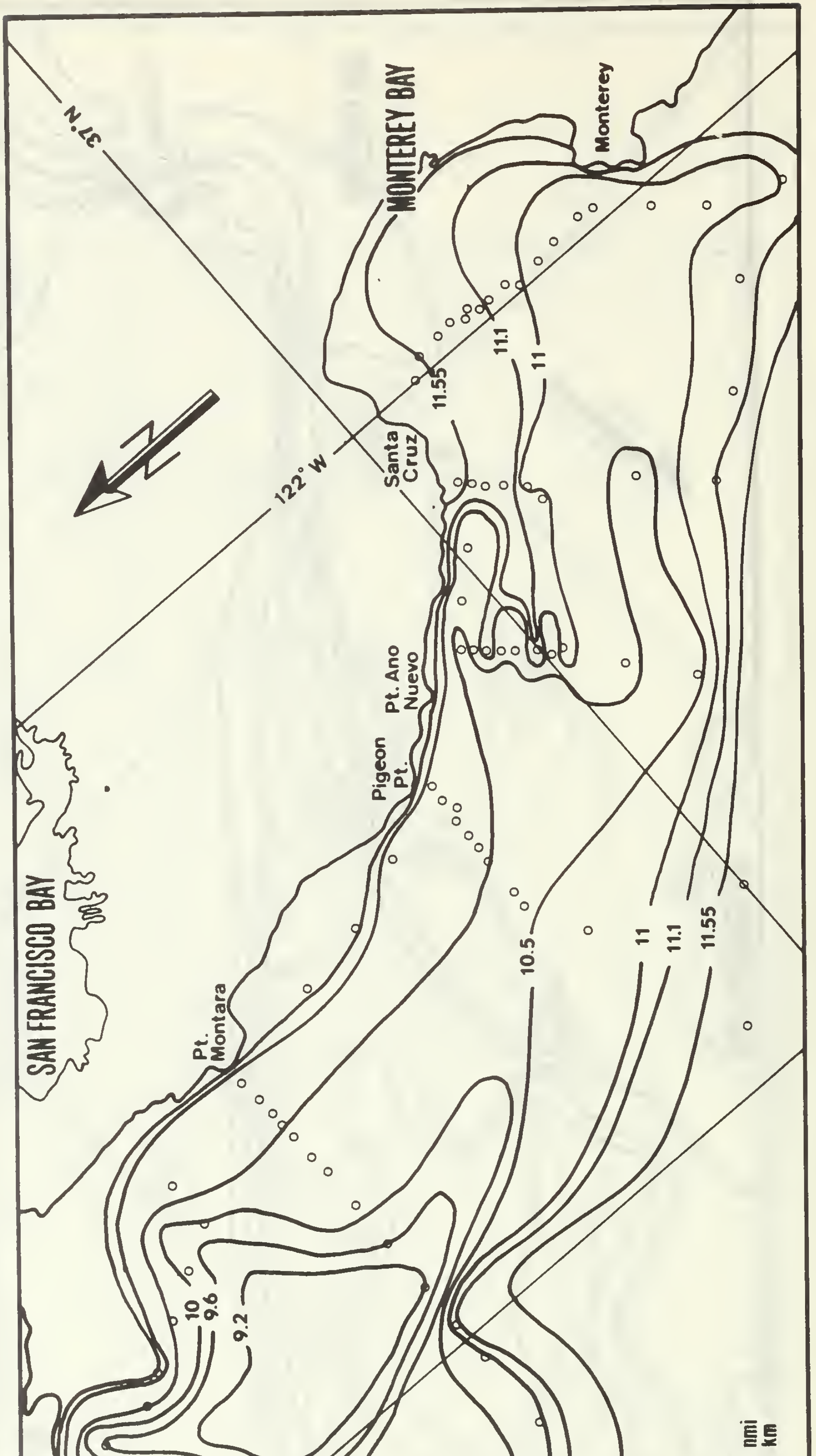
Isotherms (°C) determined from 10-19 May 1969 at the surface



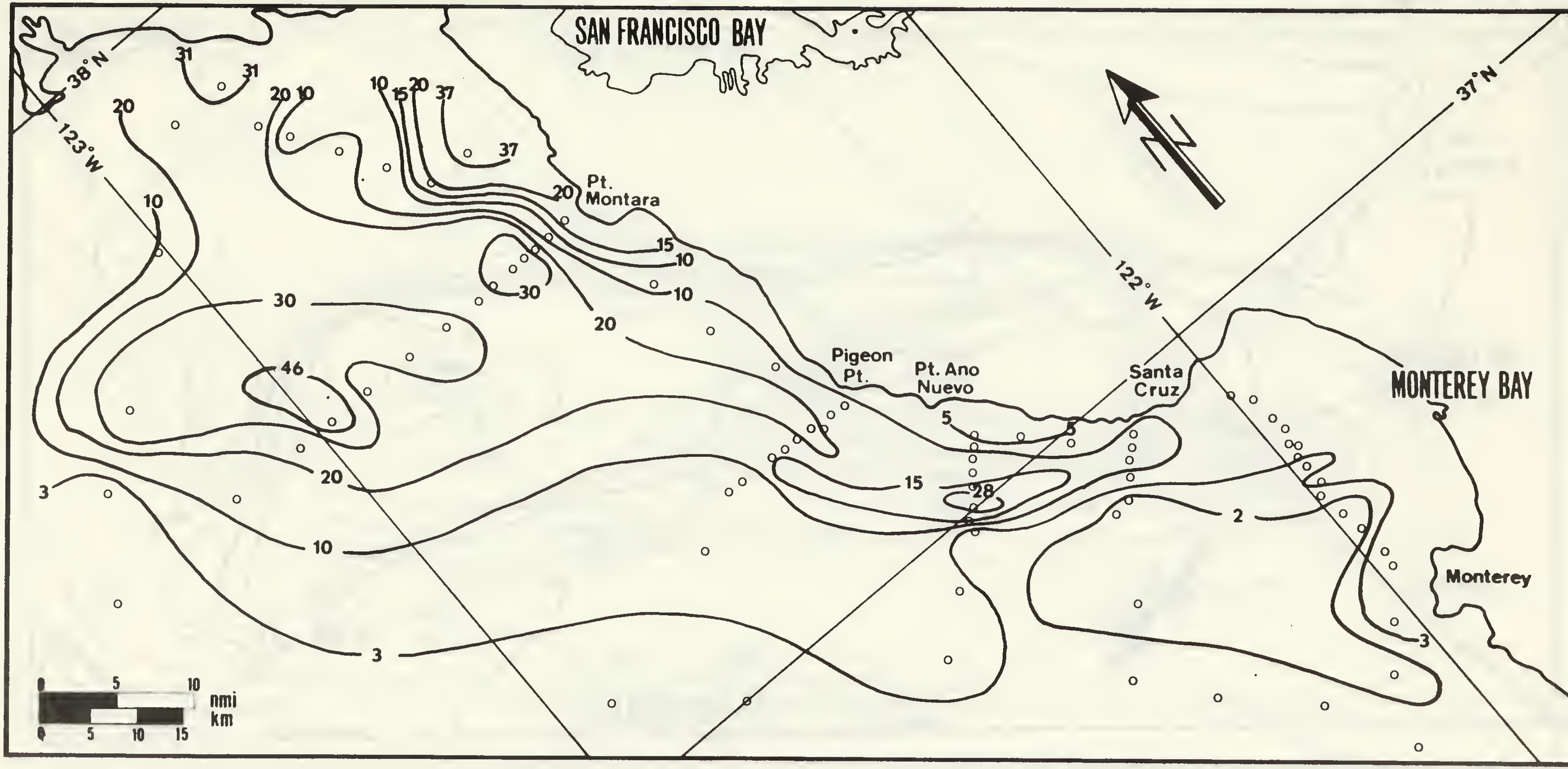
Isolines of total Coulter Count (X 10^{-2}) at the surface



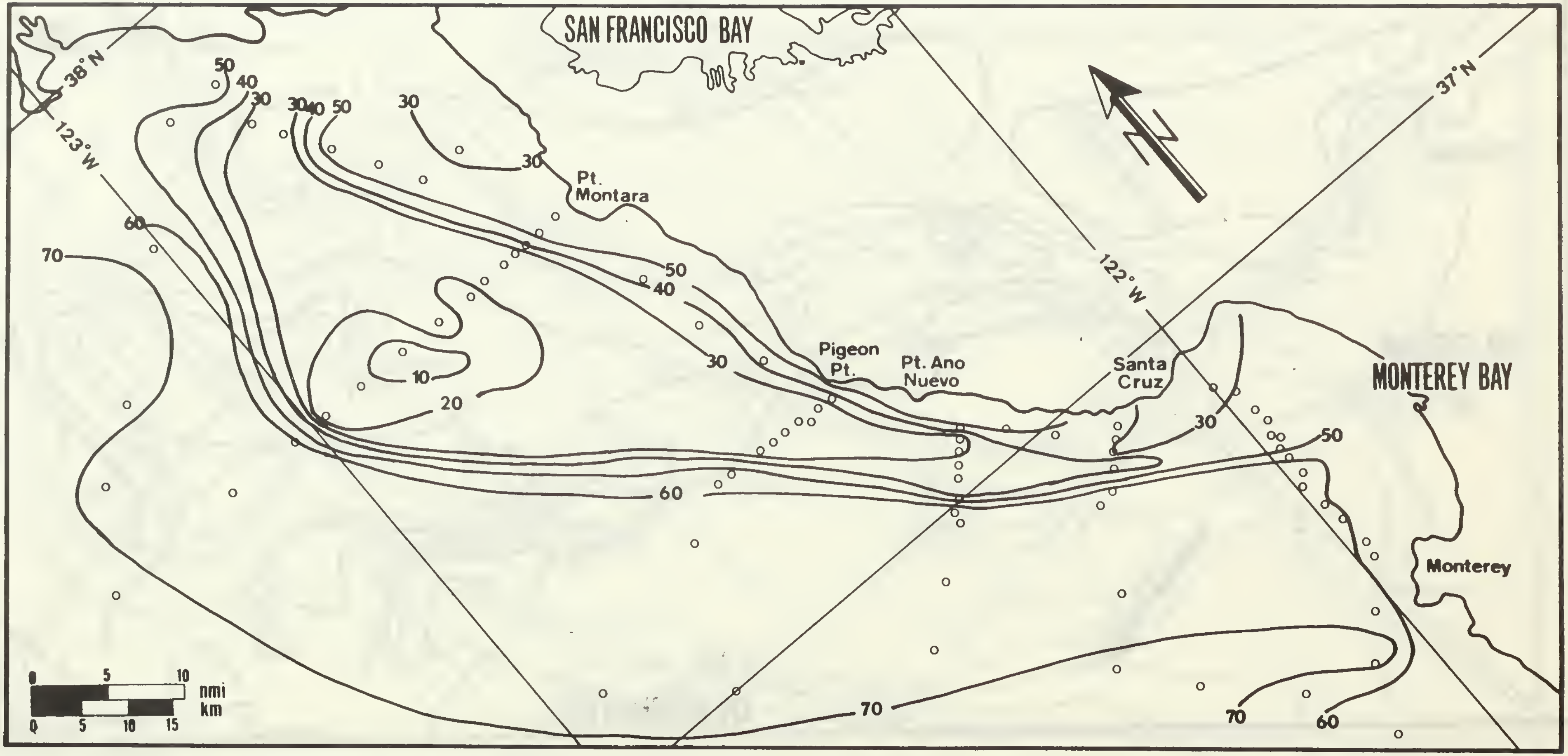
Isolines of Beam Transmittance (%/M) at the Surface



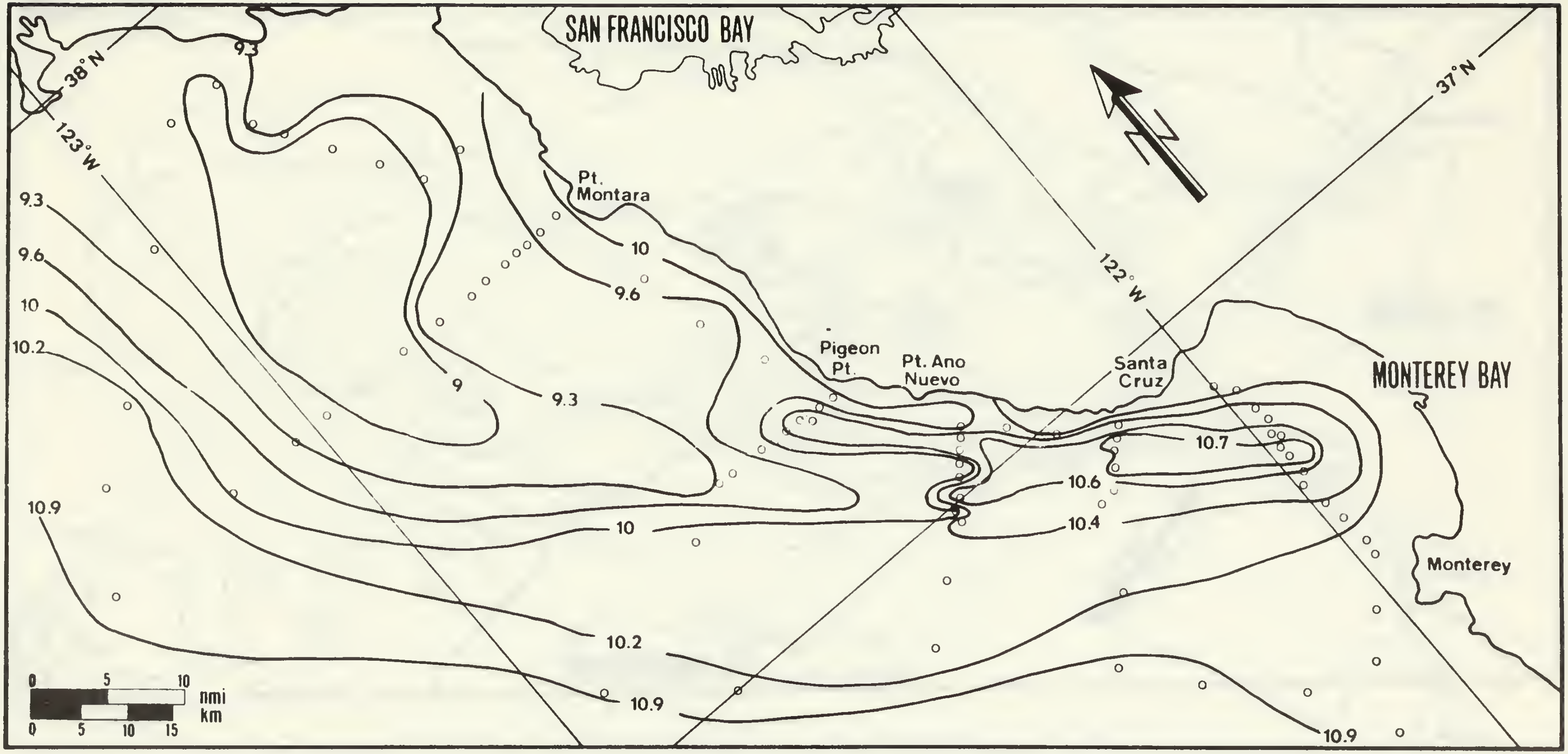
10 Meter Isotherms (°C)



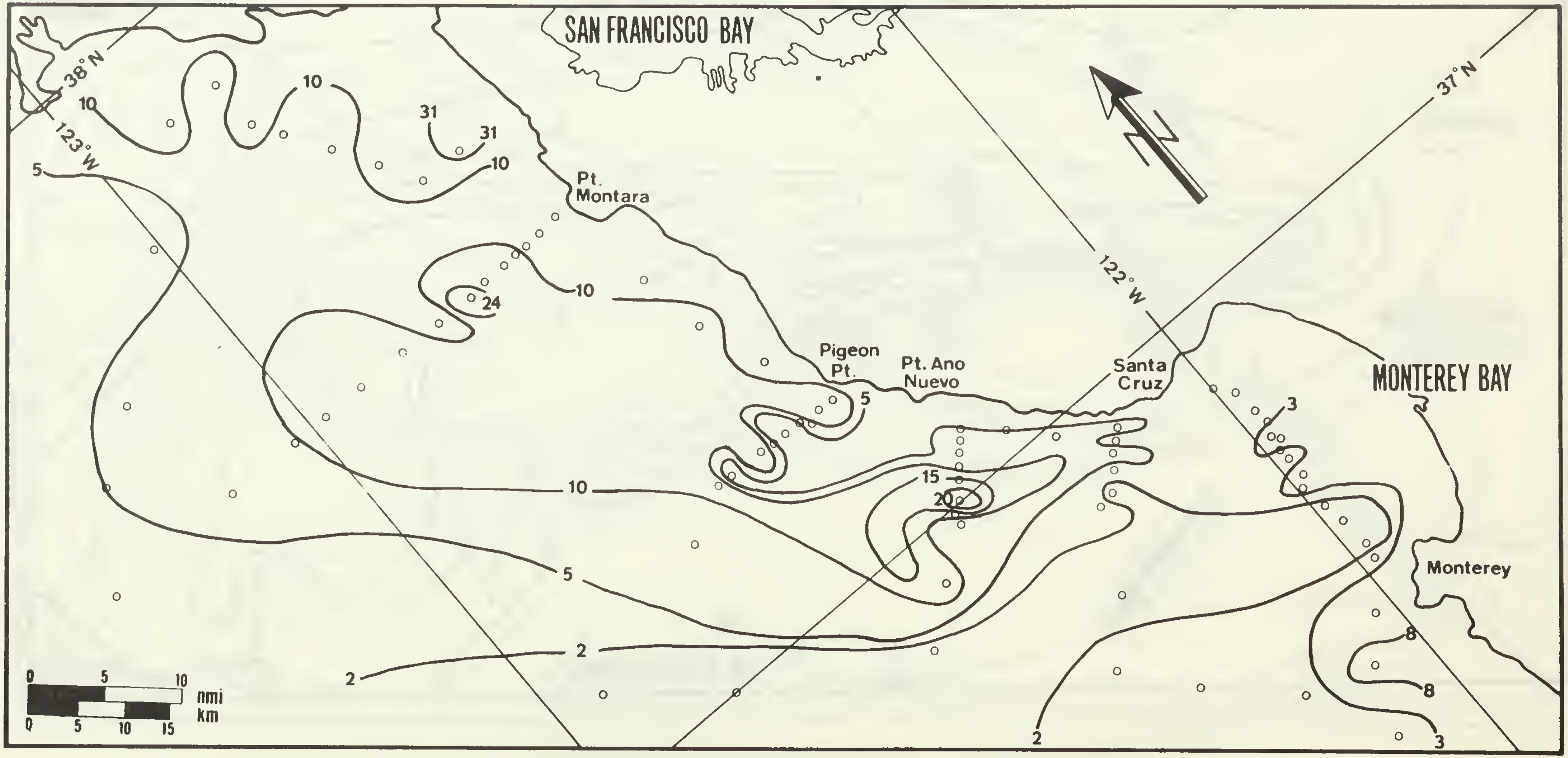
10 Meter Isolines of Total Coulter Count (X 10^{-2})



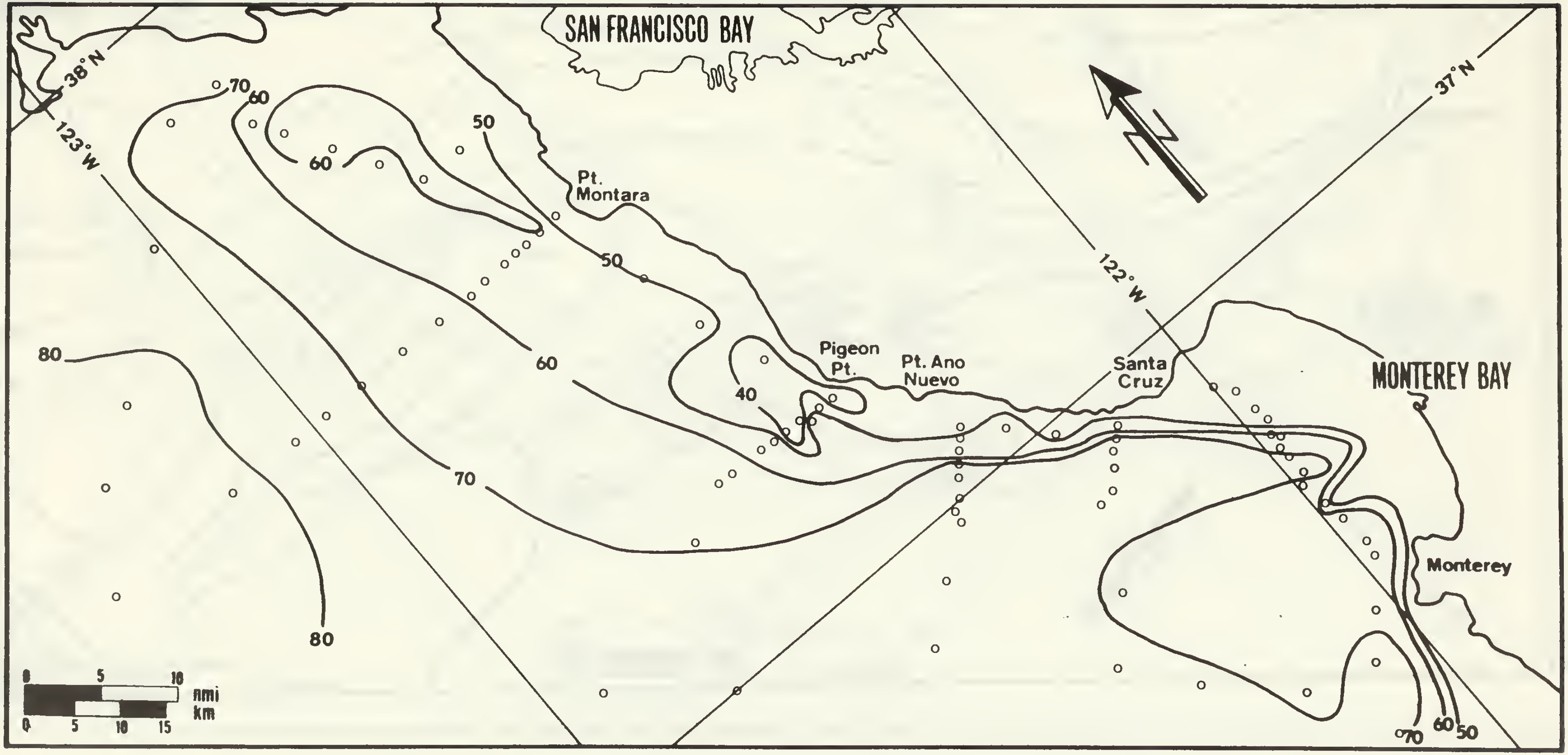
10 Meter Isolines of Beam Transmittance (%/M)



20 Meter Isotherms (°C)

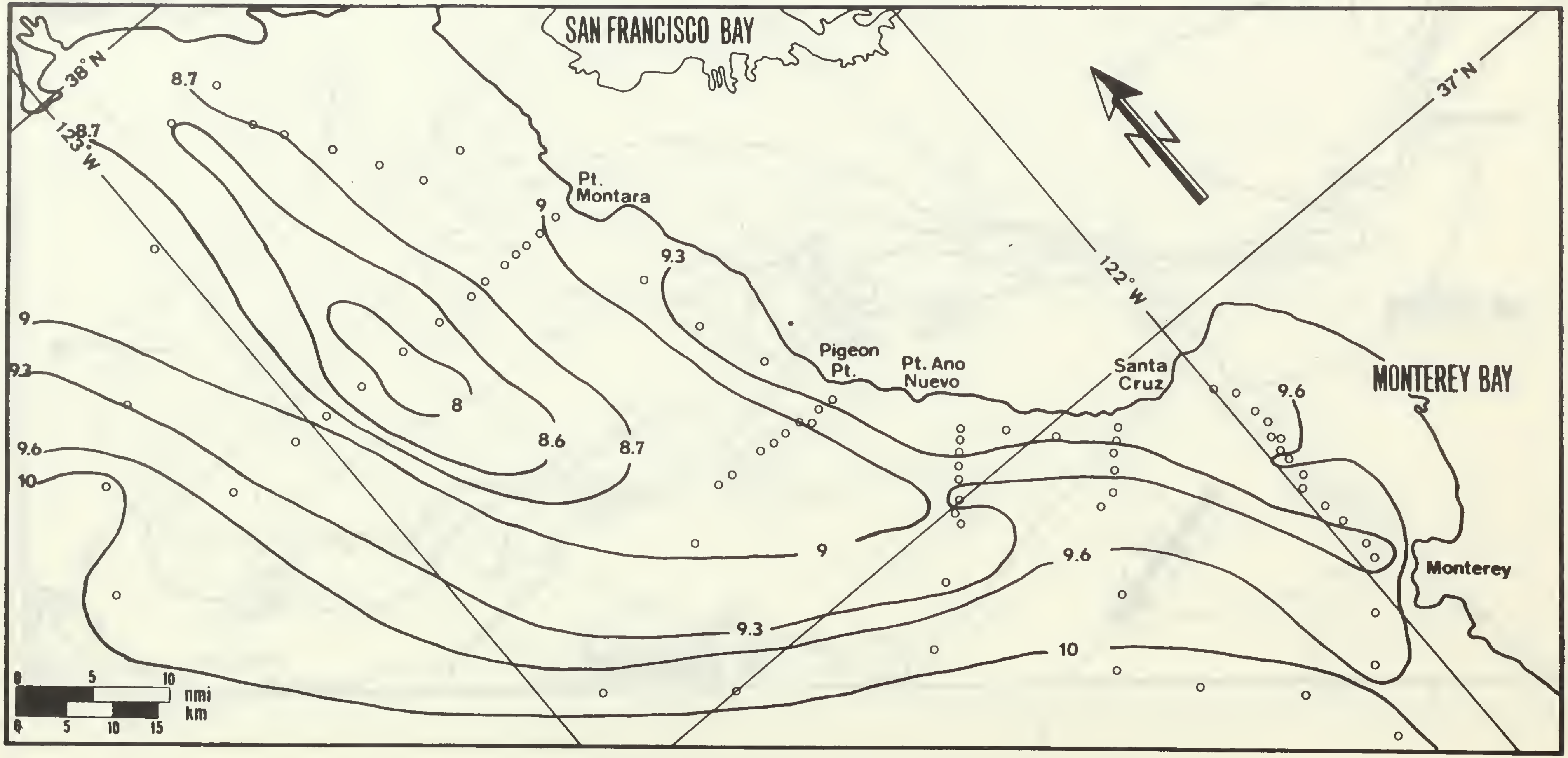


20 Meter Isolines of Total Coulter Count (X 10^{-2})



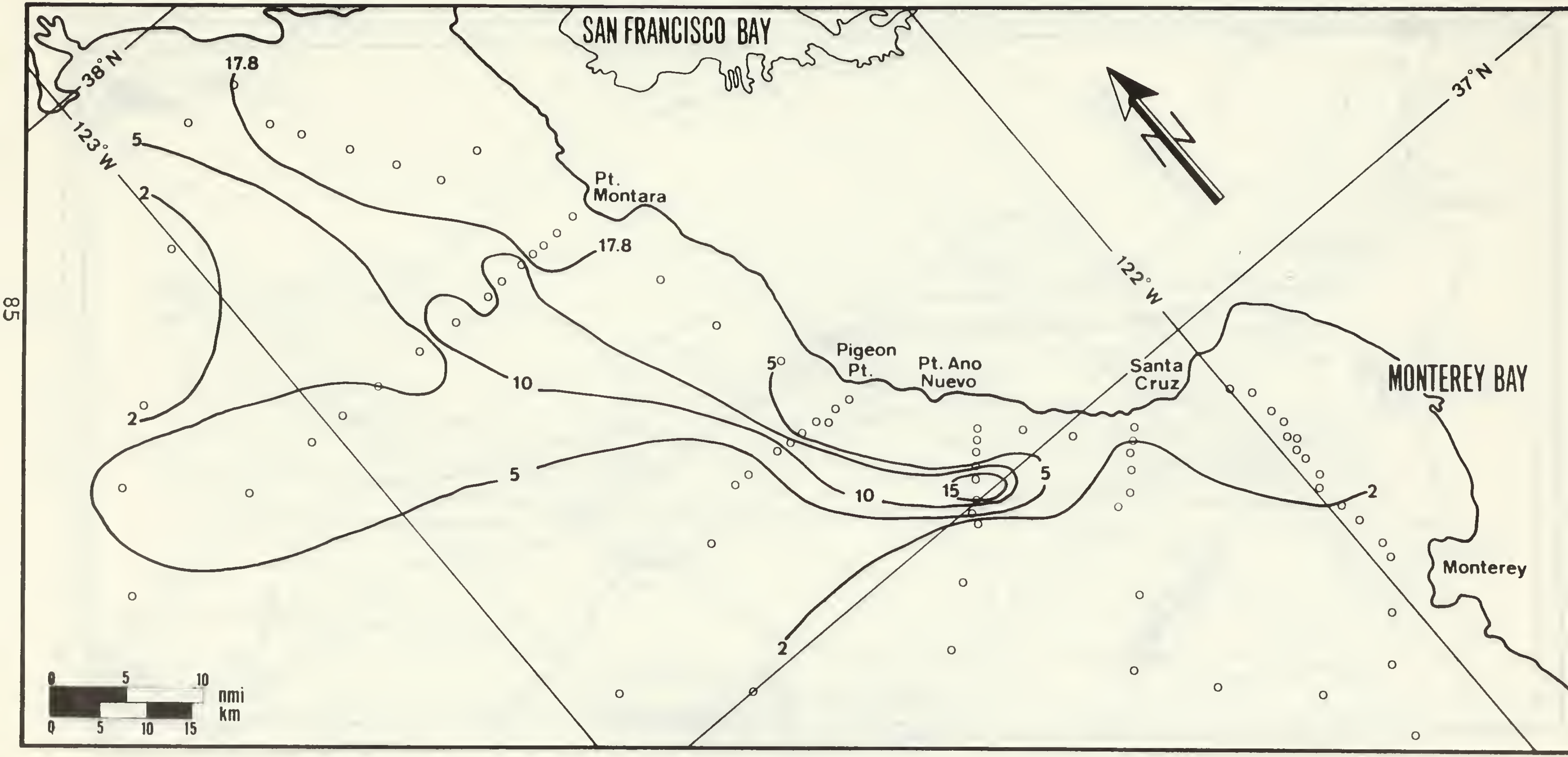
20 Meter Isolines of Beam Transmittance (%/M)

Figure 24



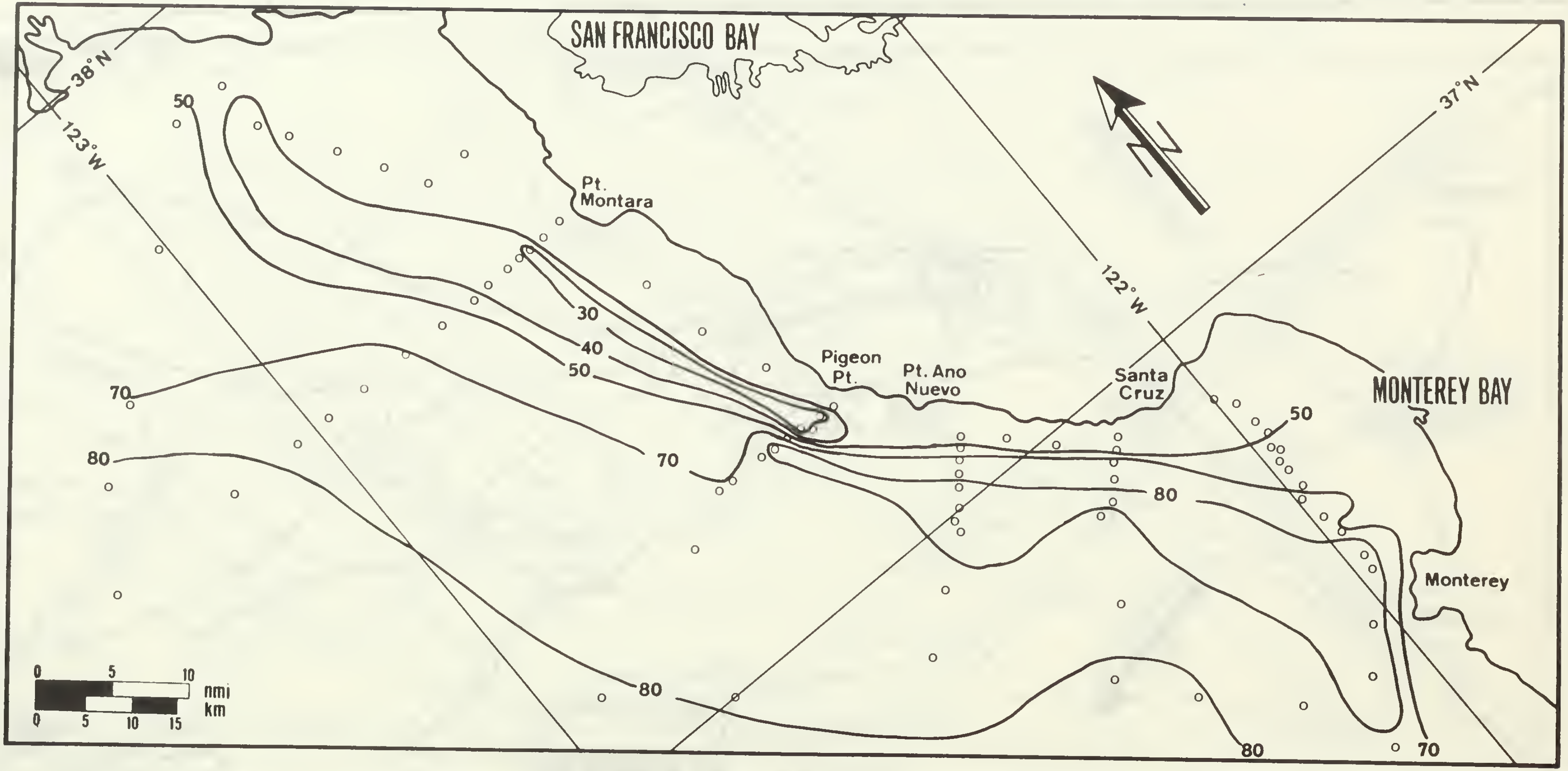
40 Meter Isotherms (°C)

Figure 25



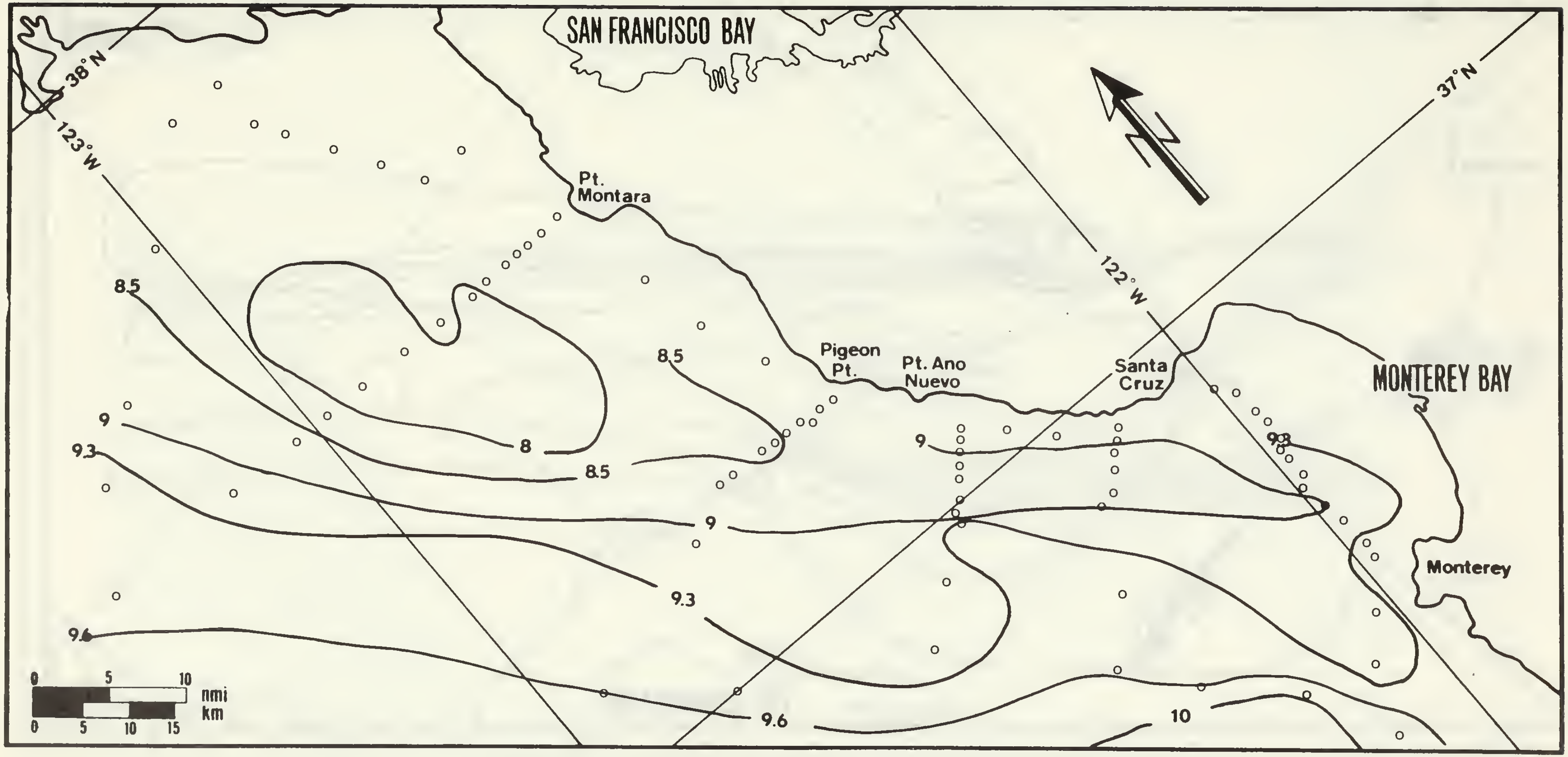
40 Meter Isolines of Total Coulter Count (X 10^{-2})

Figure 26



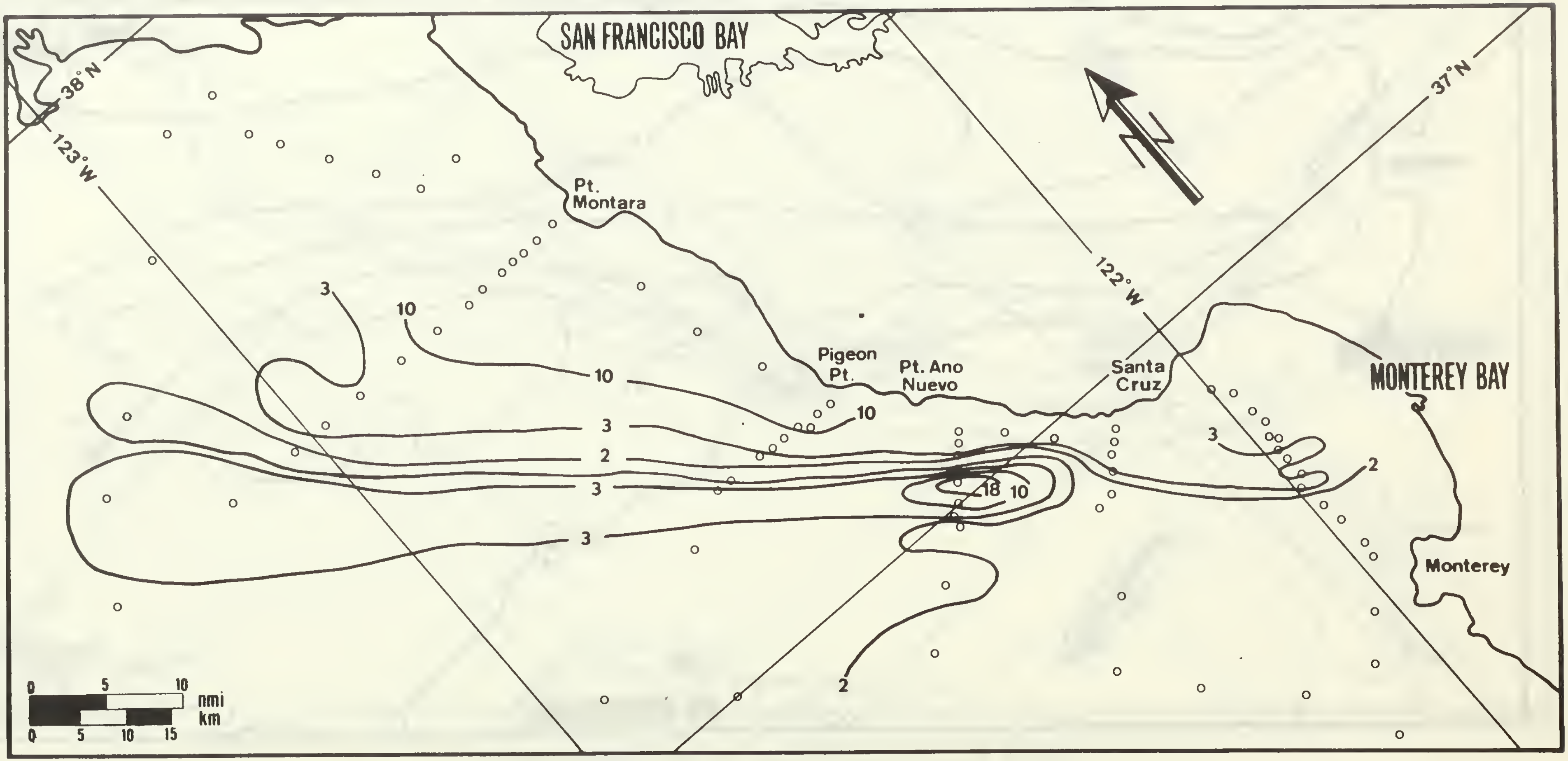
40 Meter Isolines of Beam Transmittance (%/M)

Figure 27



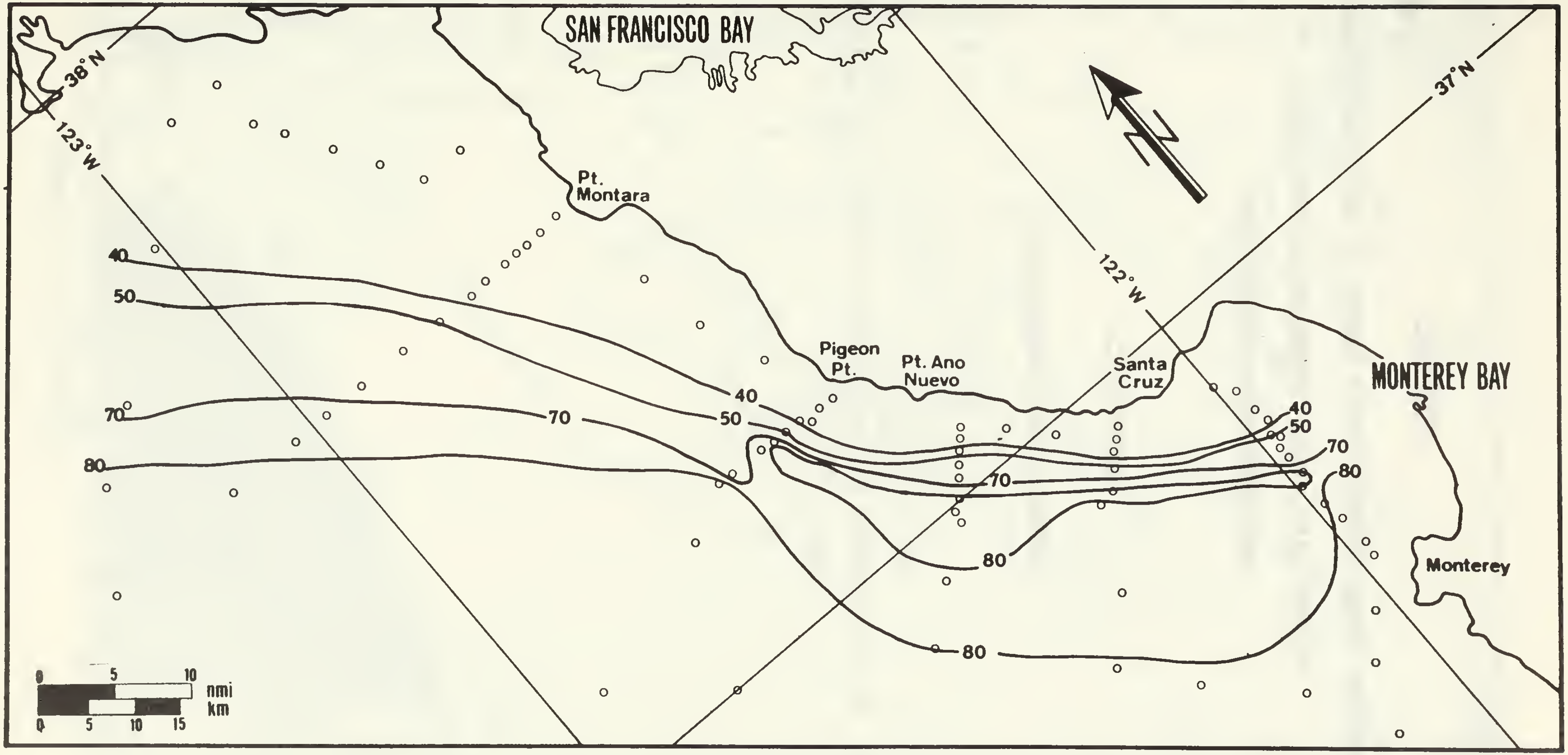
61 Meter Isotherms (°C)

Figure 28



61 Meter Isolines of Total Coulter Count (X 10^{-2})

Figure 29



61 Meter Isolines of Beam Transmittance (X 10^{-2})

Figure 30

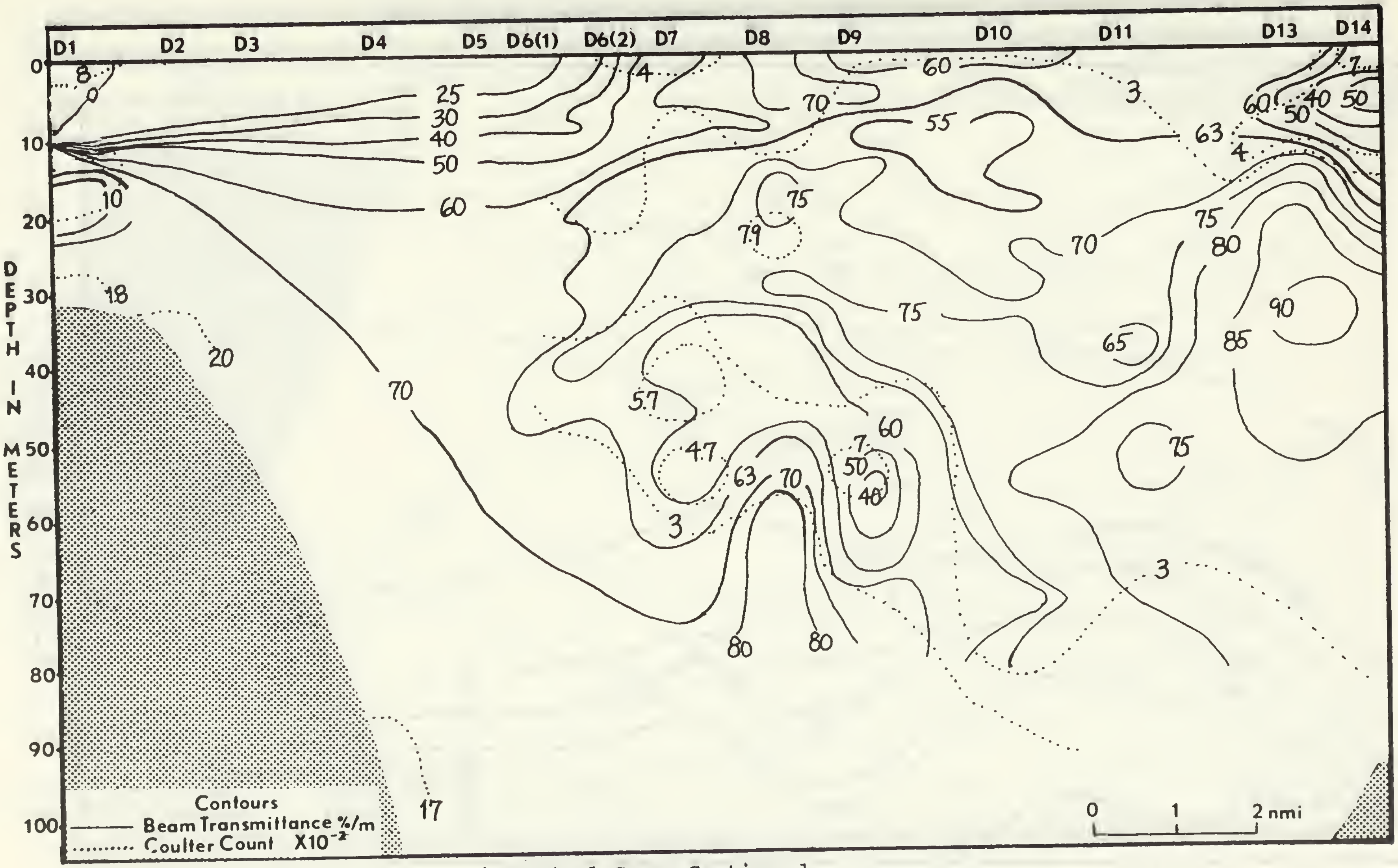
APPENDIX C

VERTICAL CROSS SECTION CONTOUR CHARTS OF BEAM TRANSMITTANCE-COULTER COUNT, BEAM TRANSMITTANCE-TEMPERATURE, AND TEMPERATURE-COULTER COUNT

APPENDIX C1

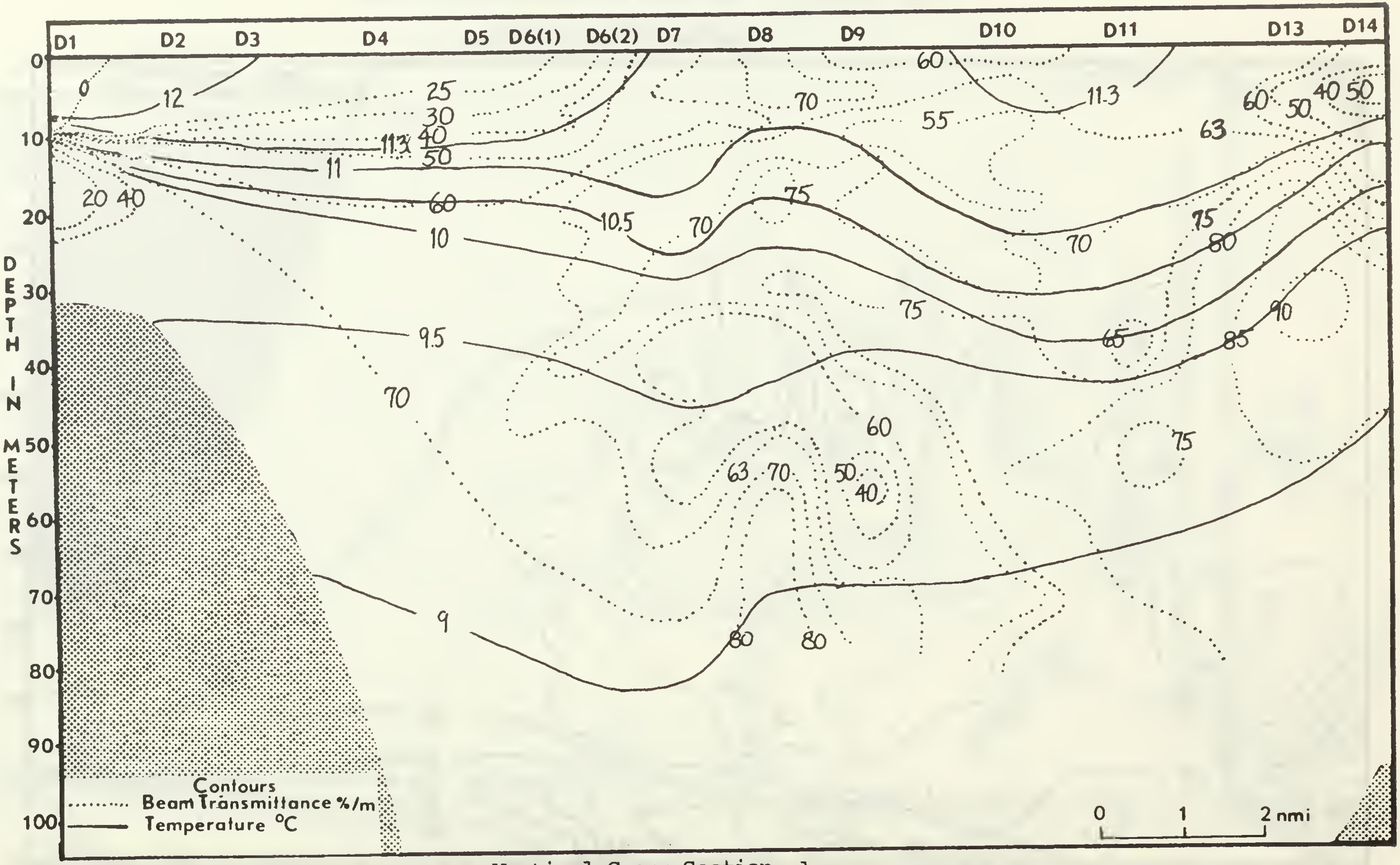
PERPENDICULAR CROSS SECTIONS

NOTE: In this APPENDIX the contour intervals are not strictly constant.



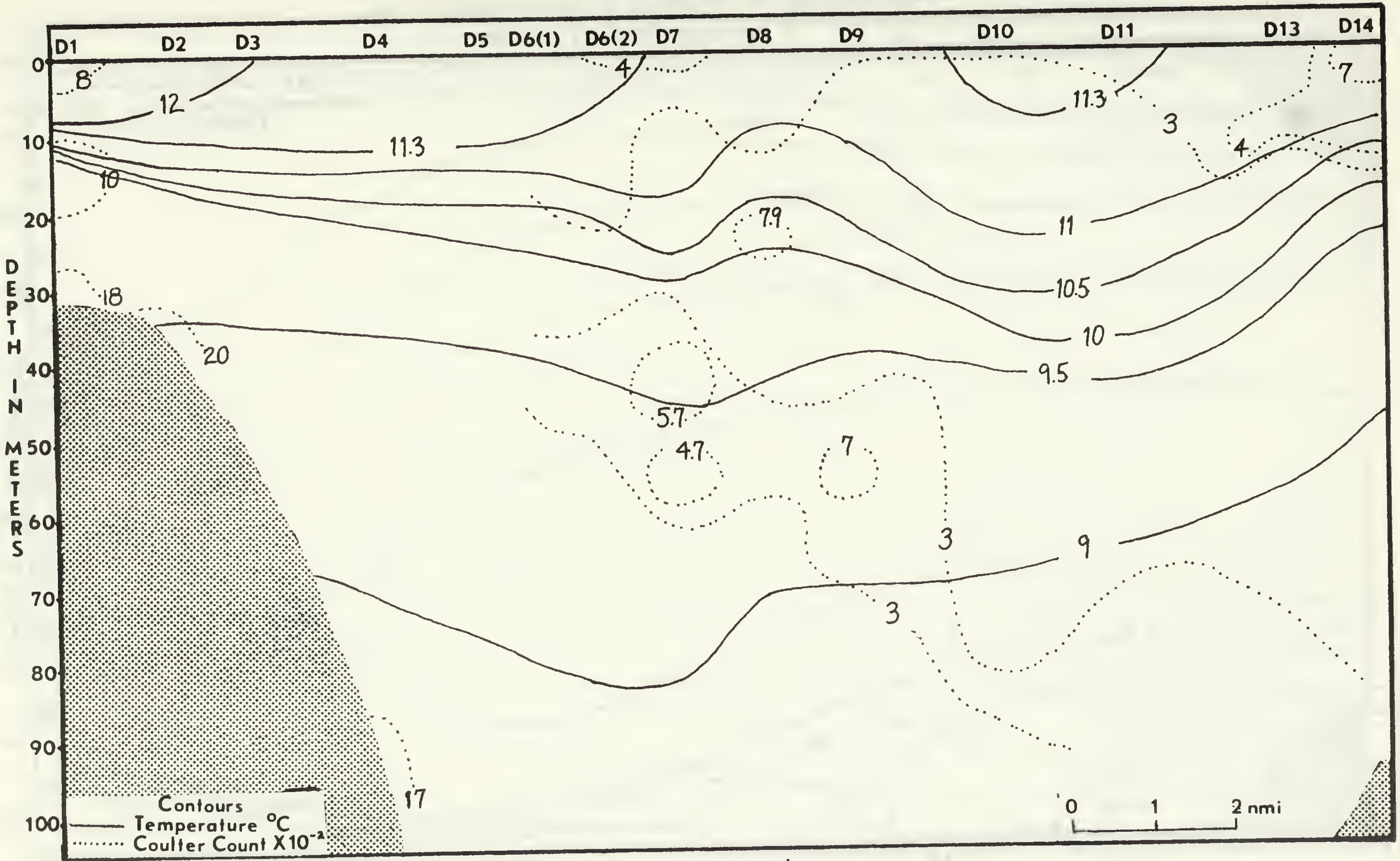
Vertical Cross Section 1

Beam Transmittance in Relation to Coulter Count

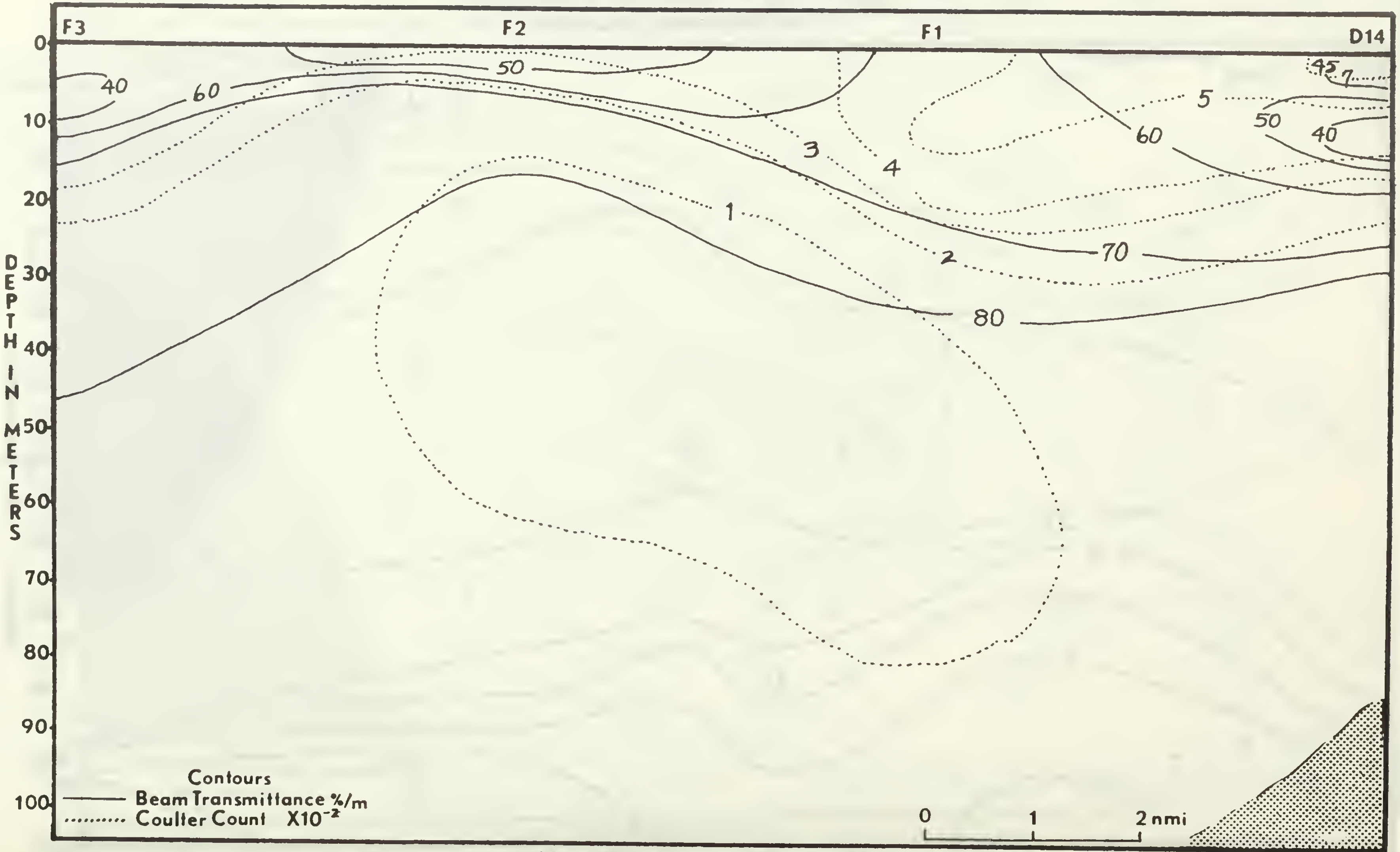


Vertical Cross Section 1

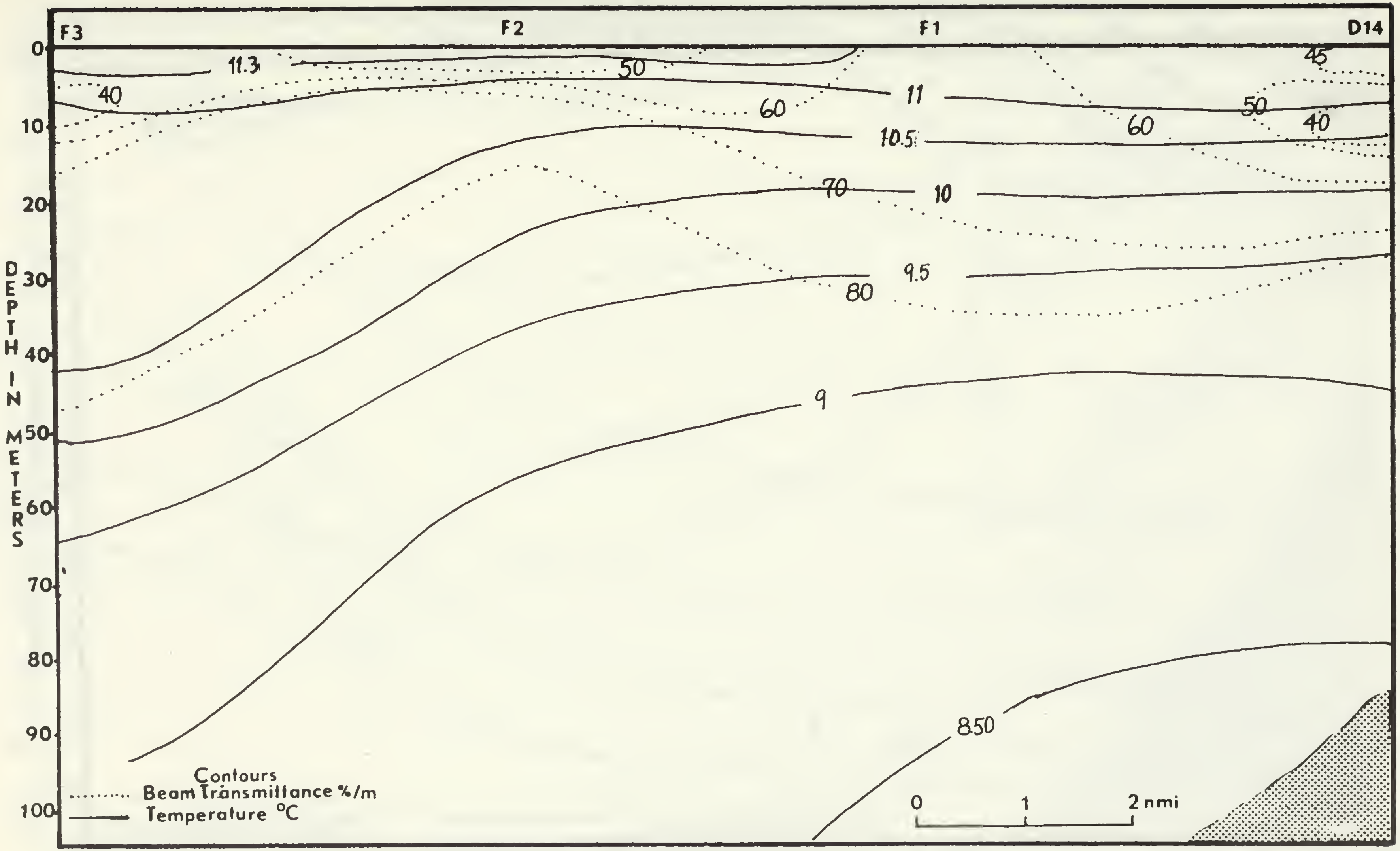
Beam Transmittance in Relation to Temperature



Vertical Cross Section 1
Temperature in Relation to Coulter Count

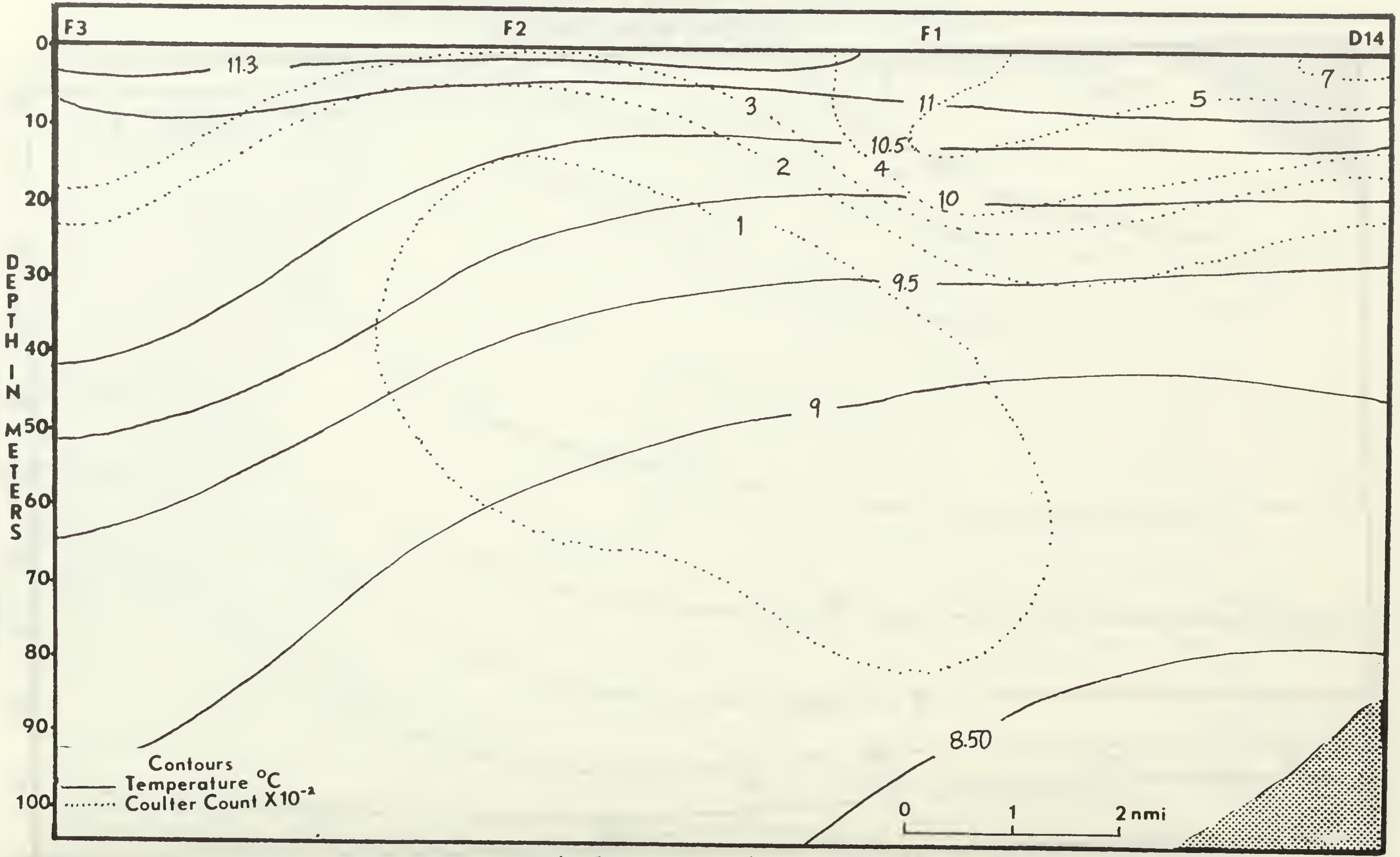


Vertical Cross Section 2
Beam Transmittance in Relation to Coulter Count



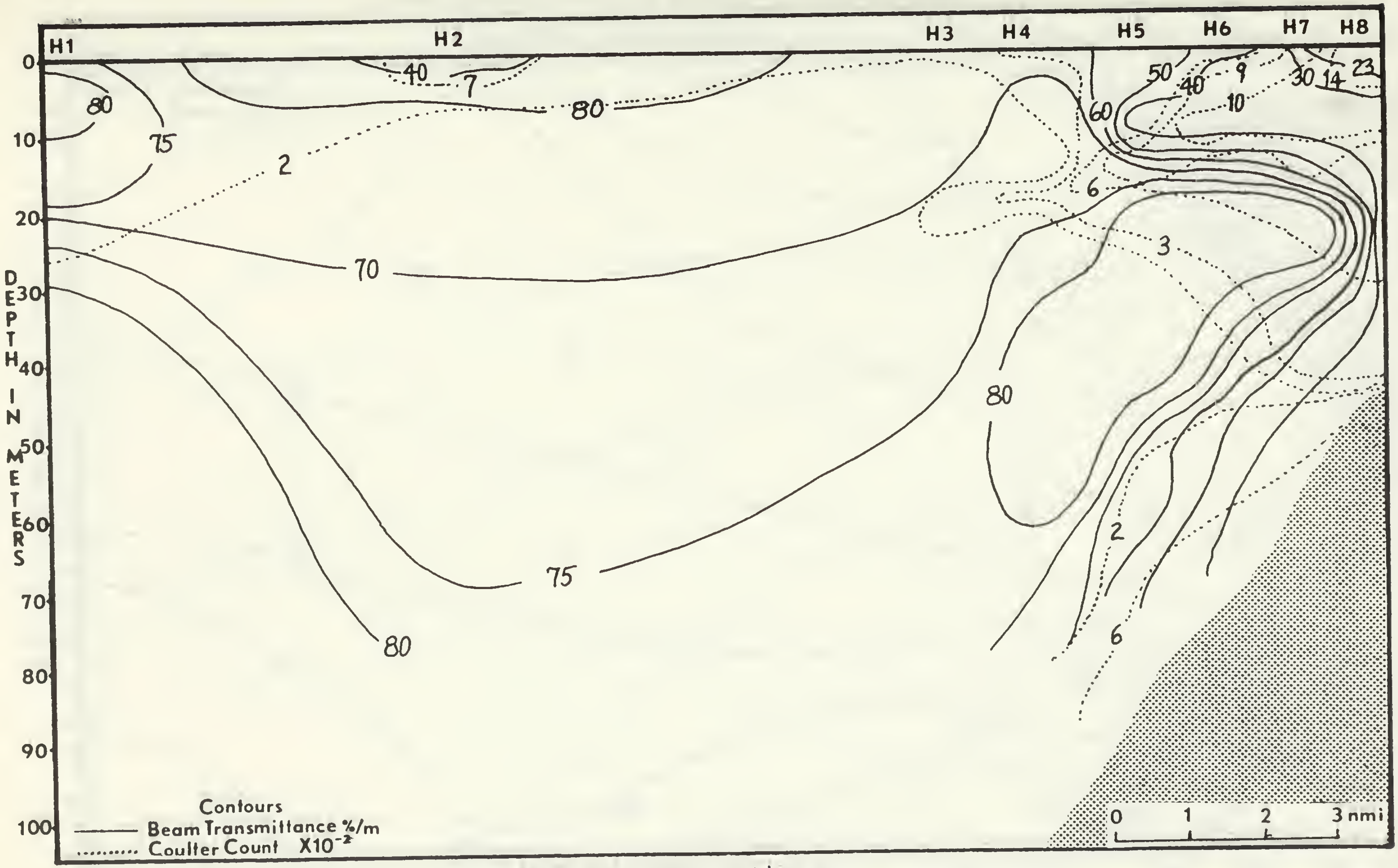
Vertical Cross Section 2

Beam Transmittance in Relation to Temperature



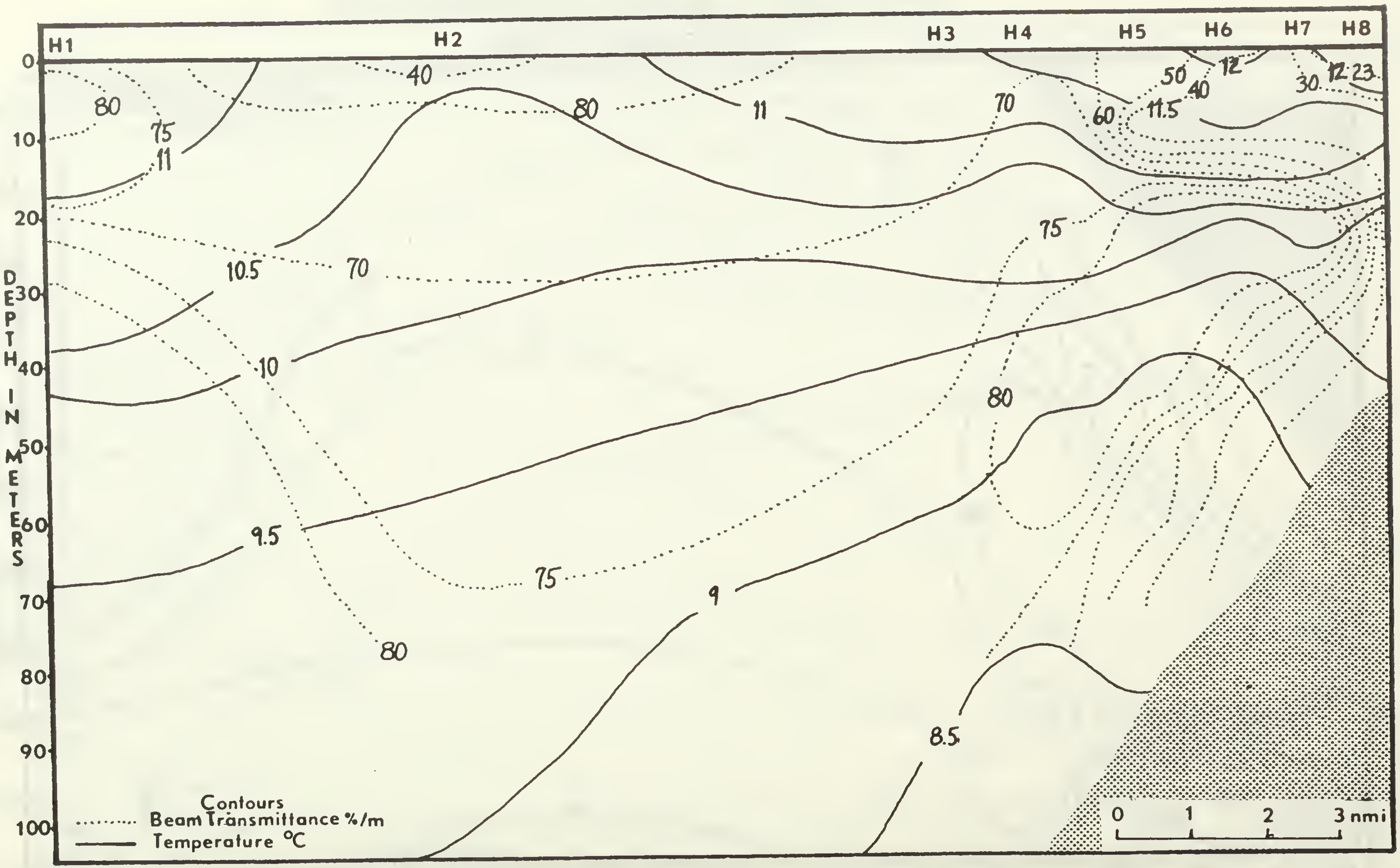
Vertical Cross Section 2

Temperature in Relation to Coulter Count



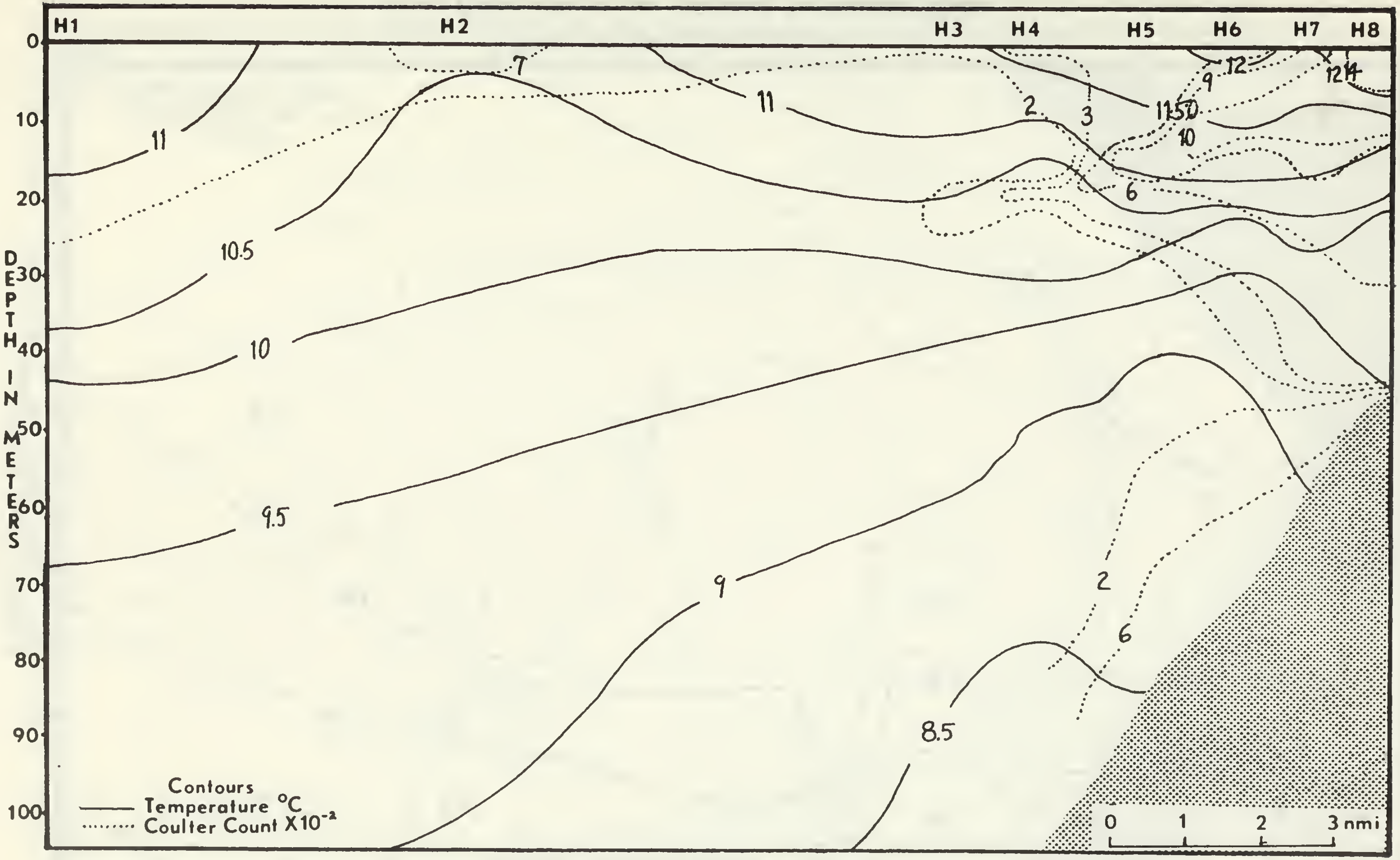
Vertical Cross Section 4

Beam Transmittance in Relation to Coulter Count



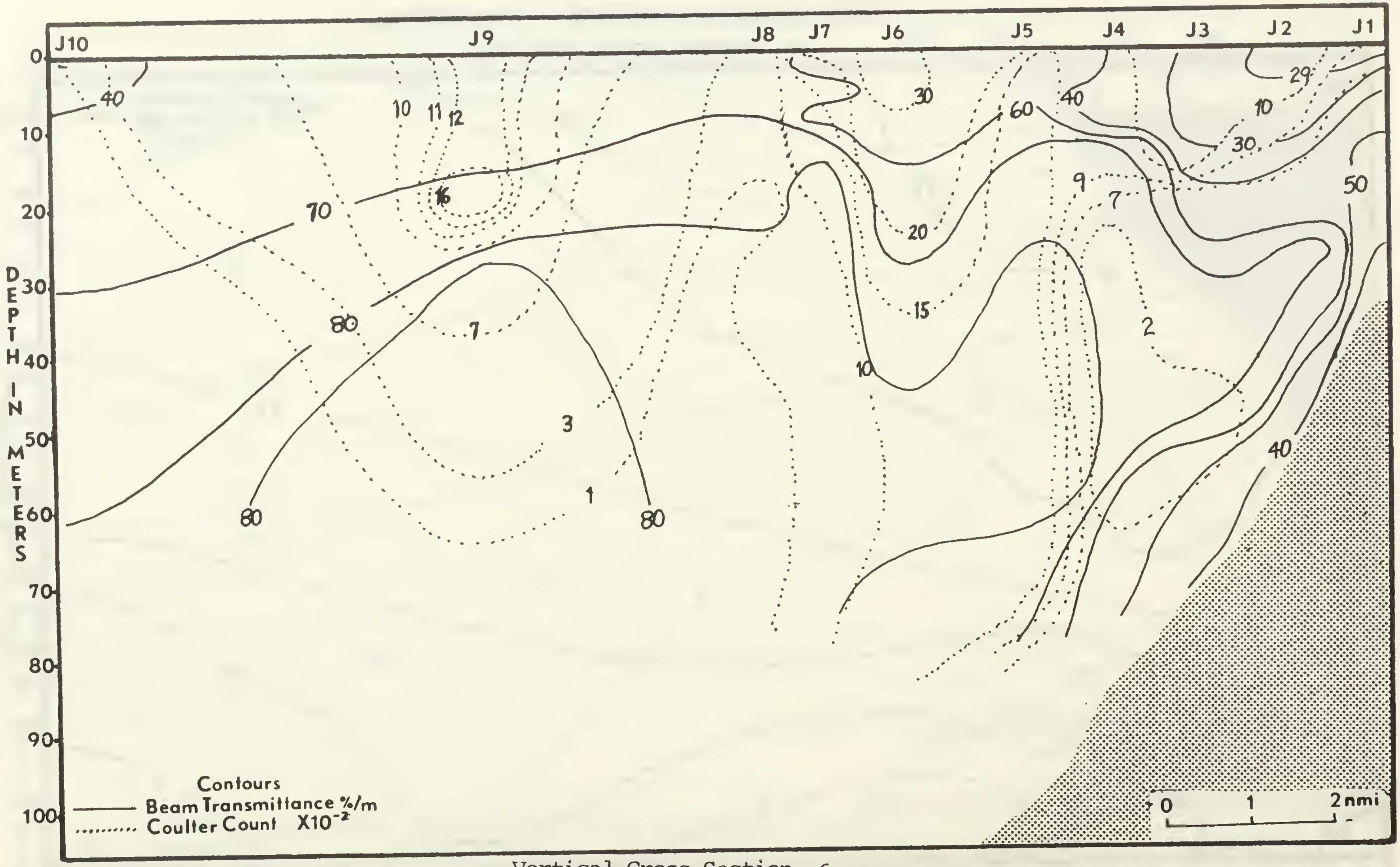
Vertical Cross Section 4

Beam Transmittance in Relation to Temperature



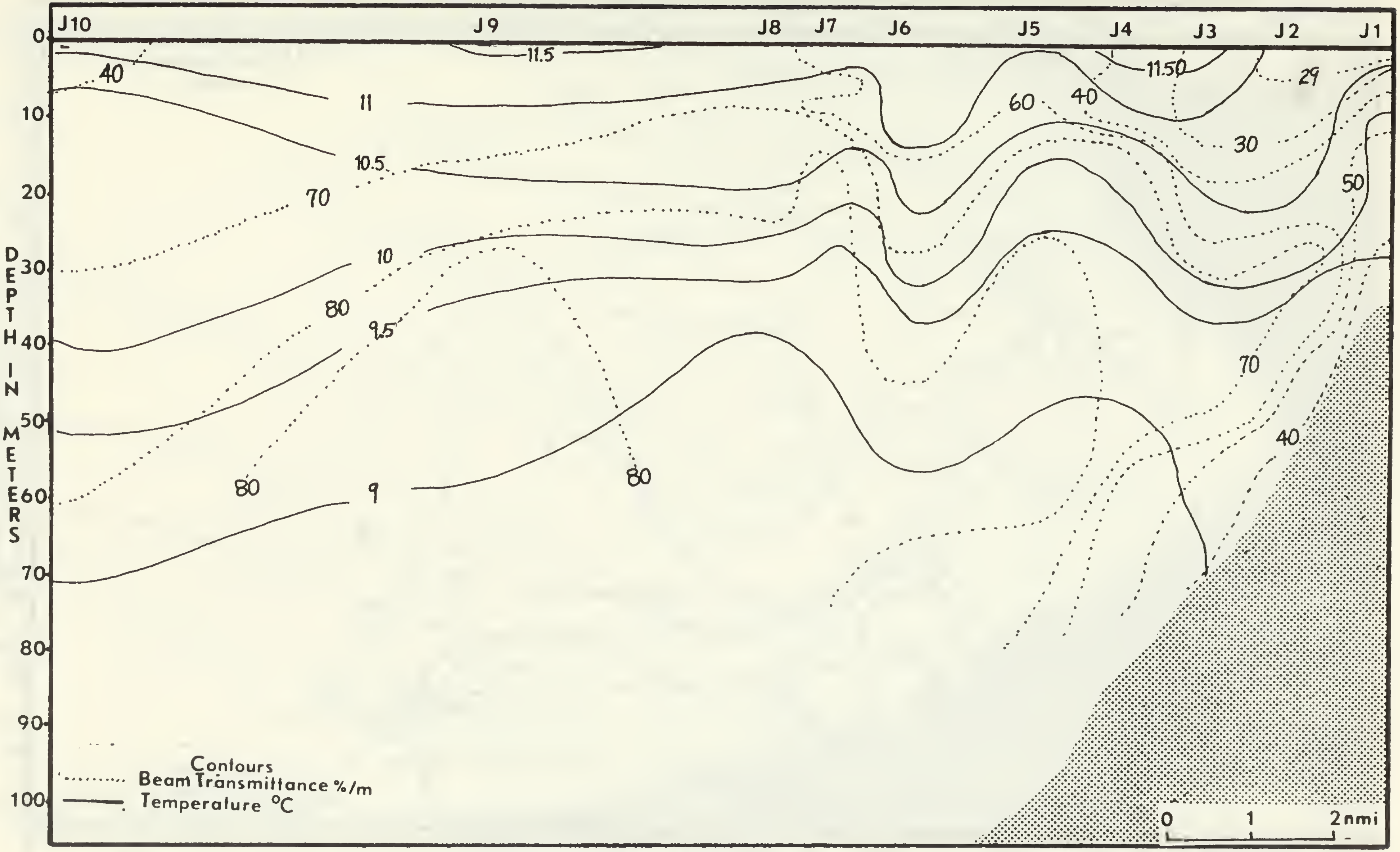
Vertical Cross Section 4

Temperature in Relation to Coulter Count



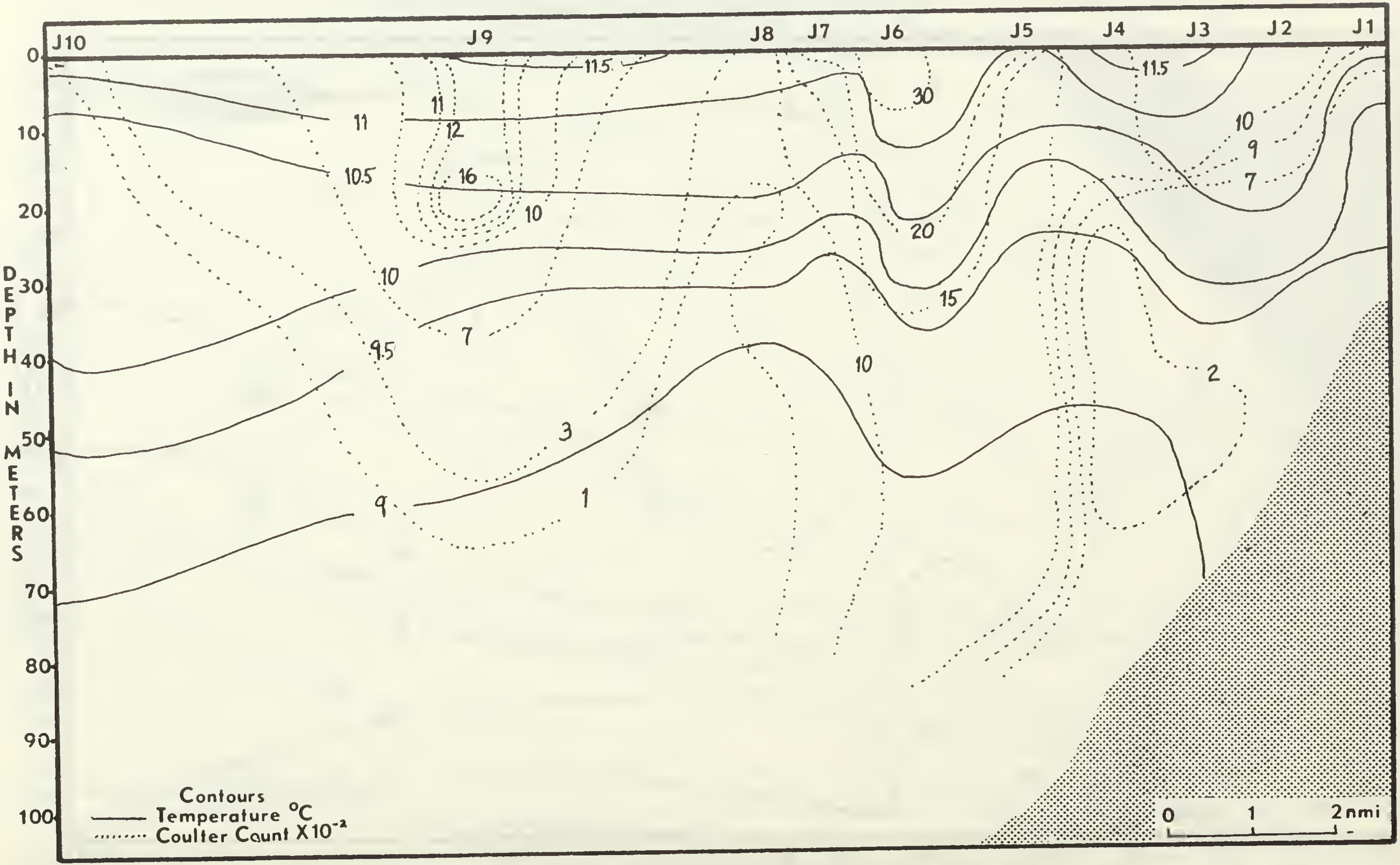
Vertical Cross Section 6

Beam Transmittance in Relation to Coulter Count



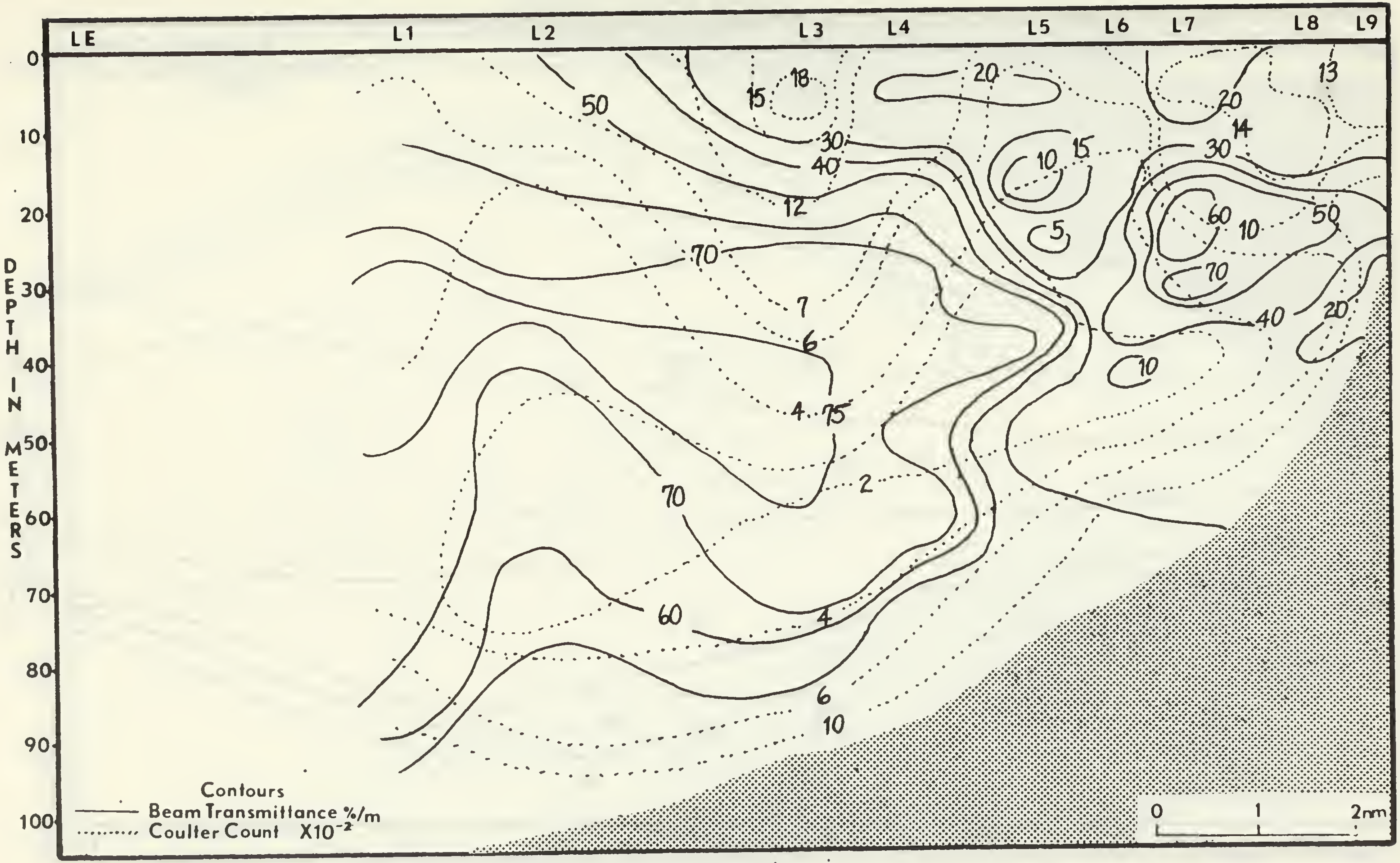
Vertical Cross Section 6

Beam Transmittance in Relation to Temperature

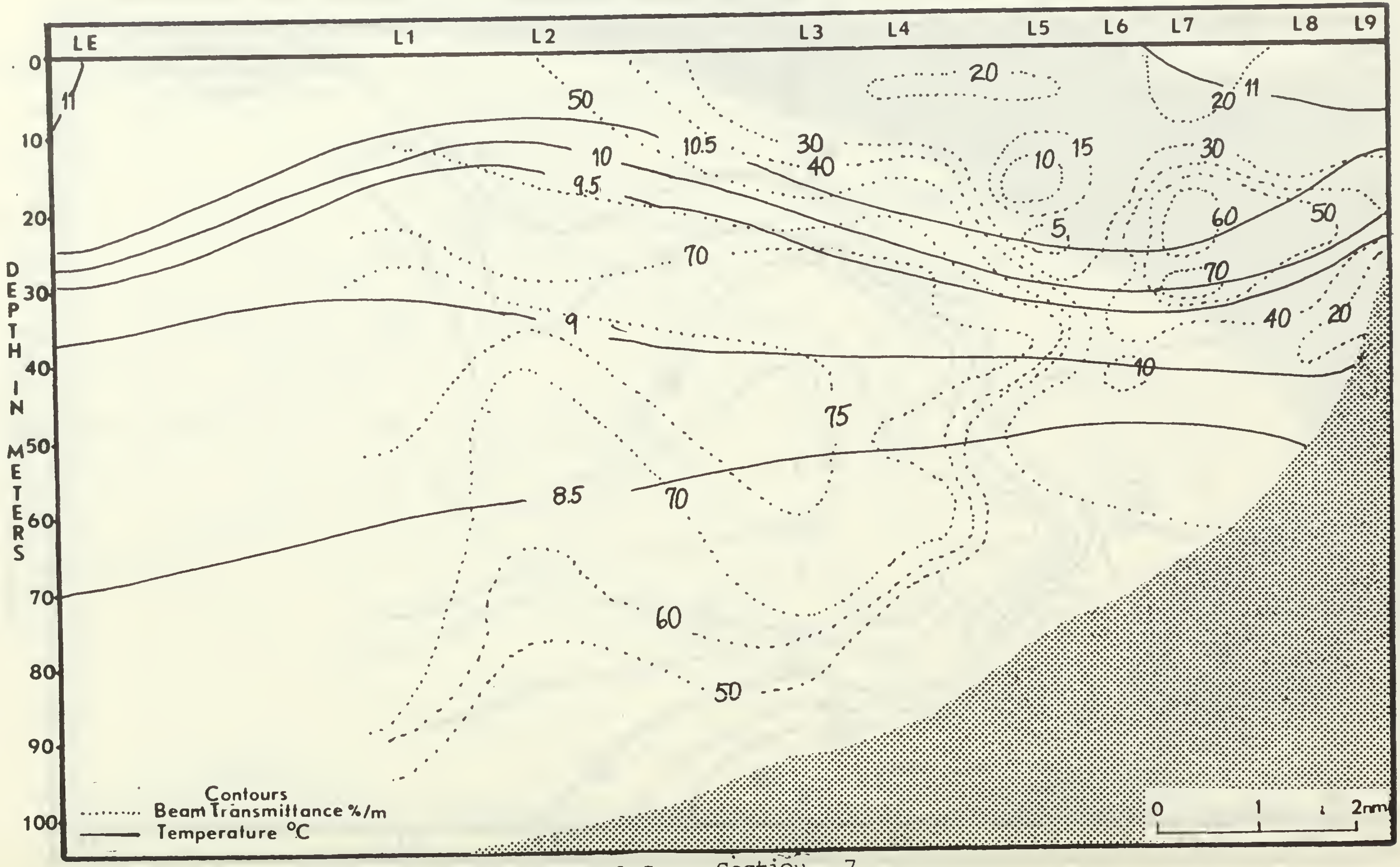


Vertical Cross Section 6

Temperature in Relation to Coulter Count

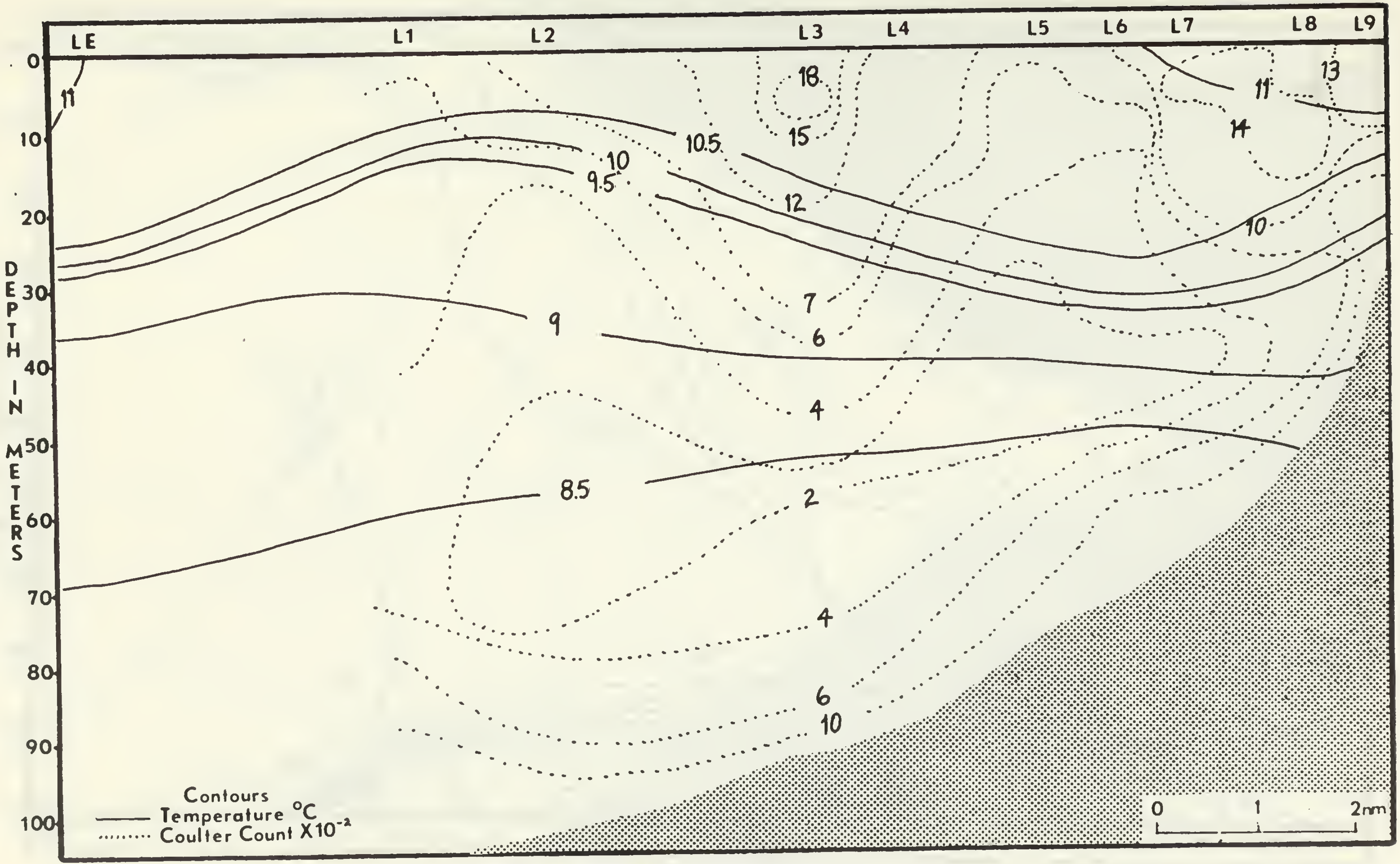


Vertical Cross Section 7
Beam Transmittance in Relation to Coulter Count



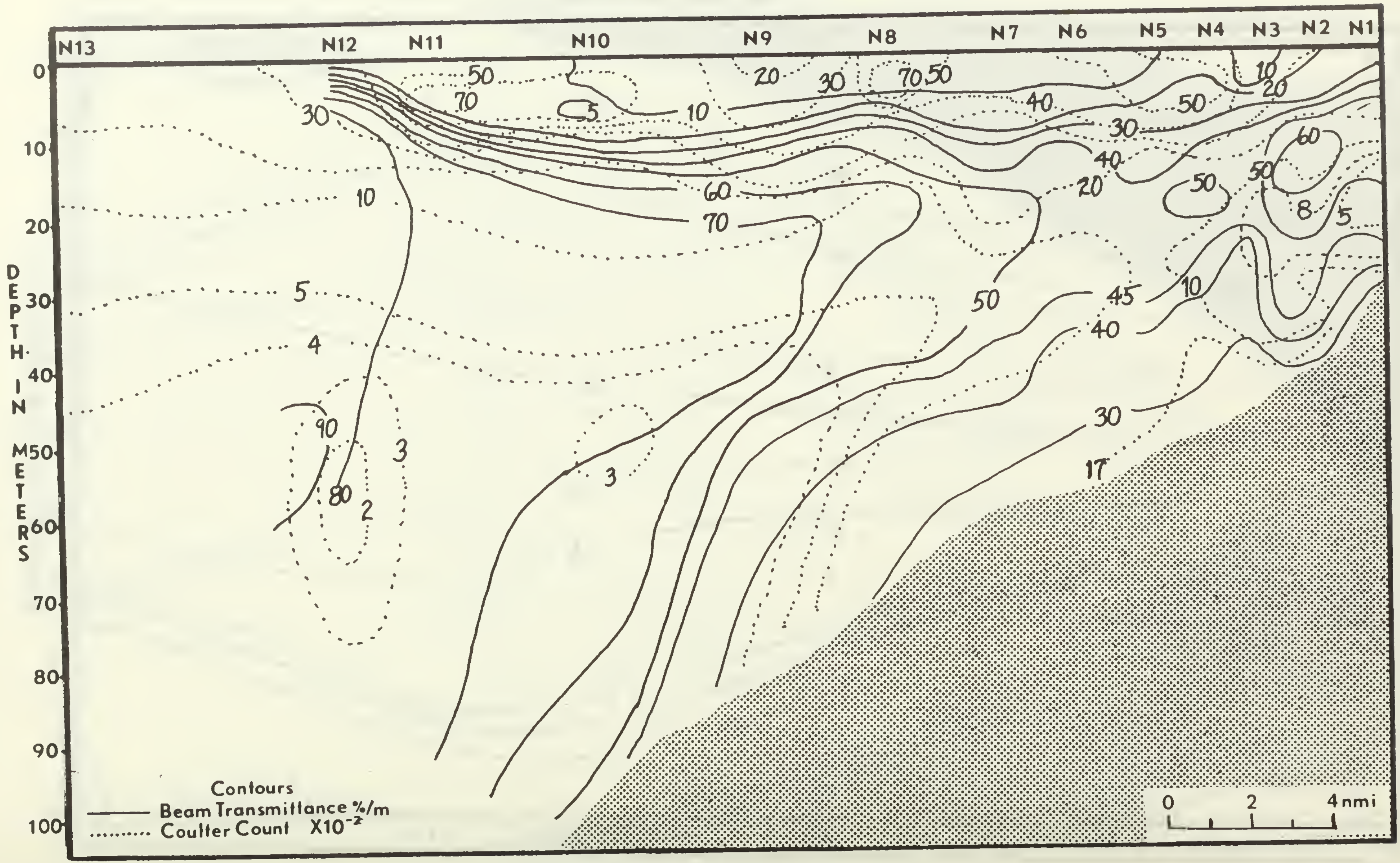
Vertical Cross Section 7

Beam Transmittance in Relation to Temperature



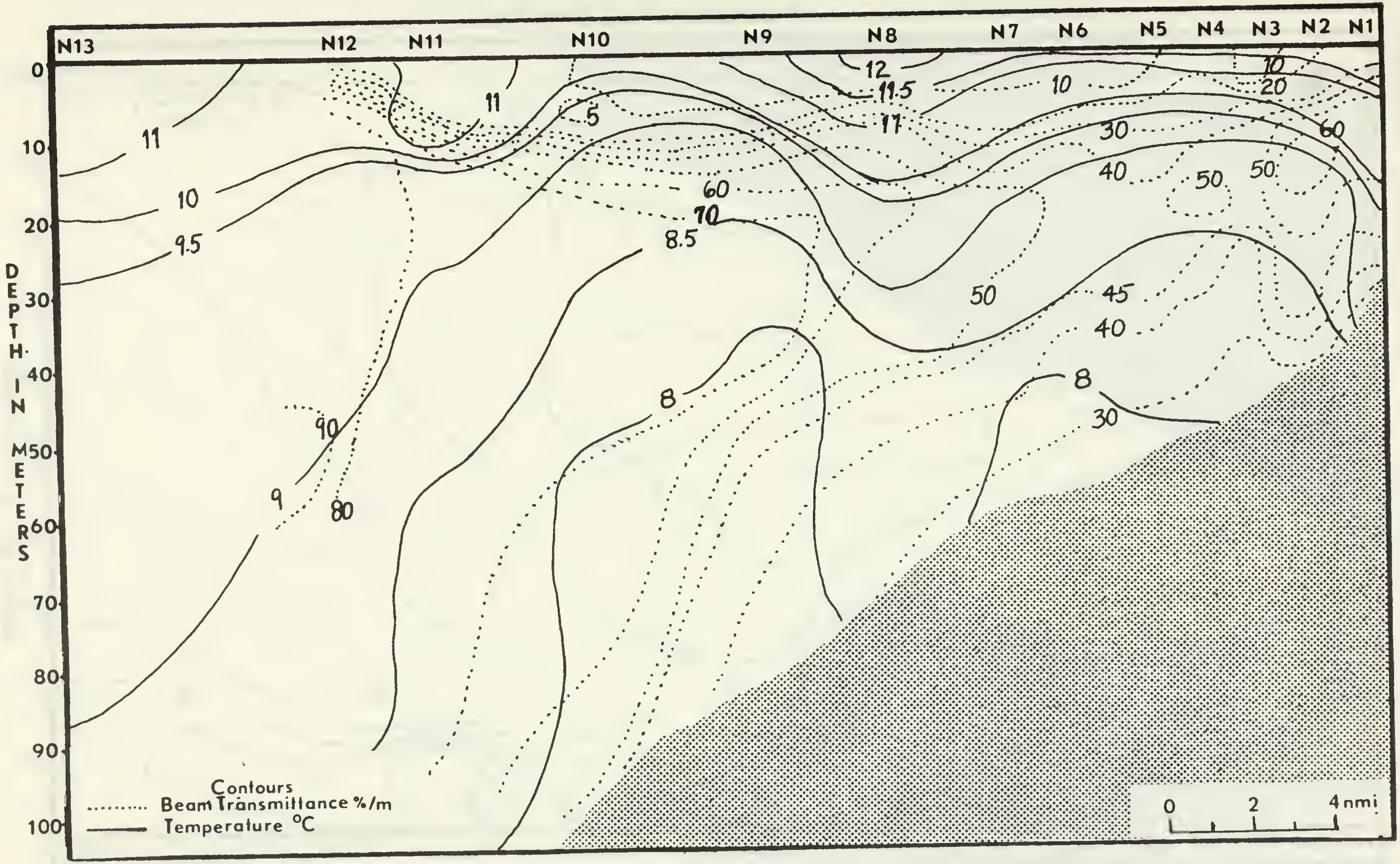
Vertical Cross Section 7

Temperature in Relation to Coulter Count

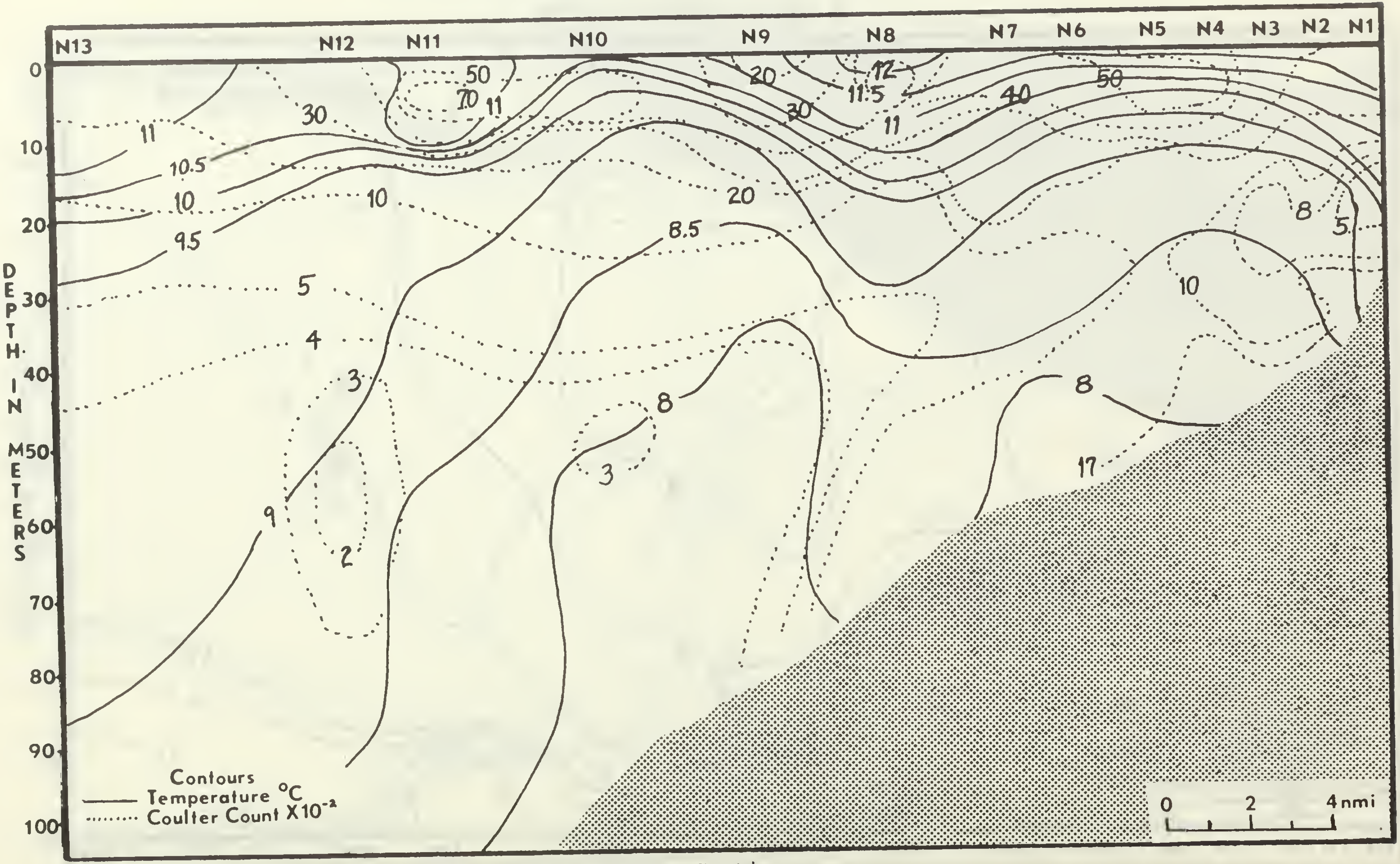


Vertical Cross Section 8

Beam Transmittance in Relation to Coulter Count

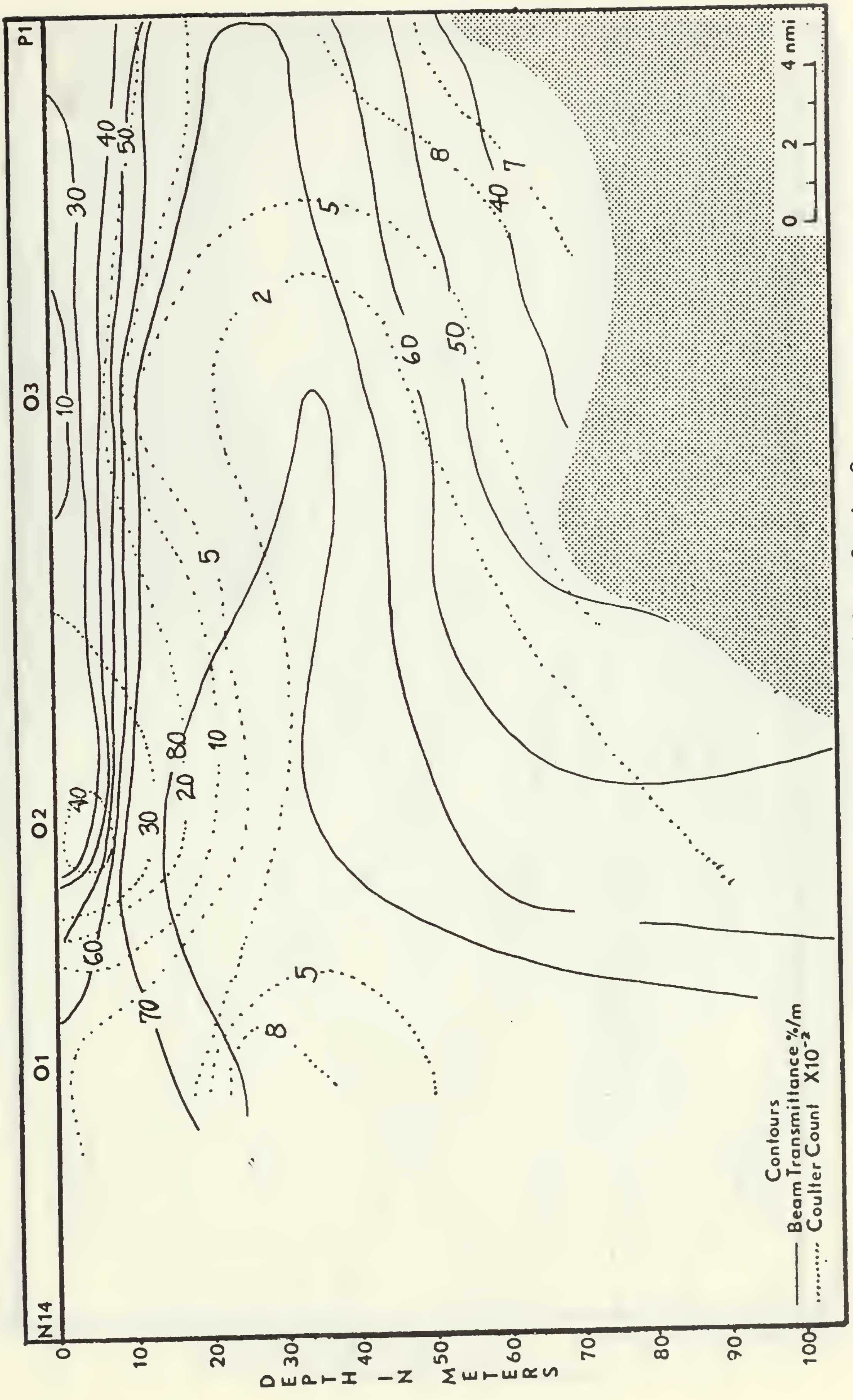


Vertical Cross Section 8
Beam Transmittance in Relation to Temperature



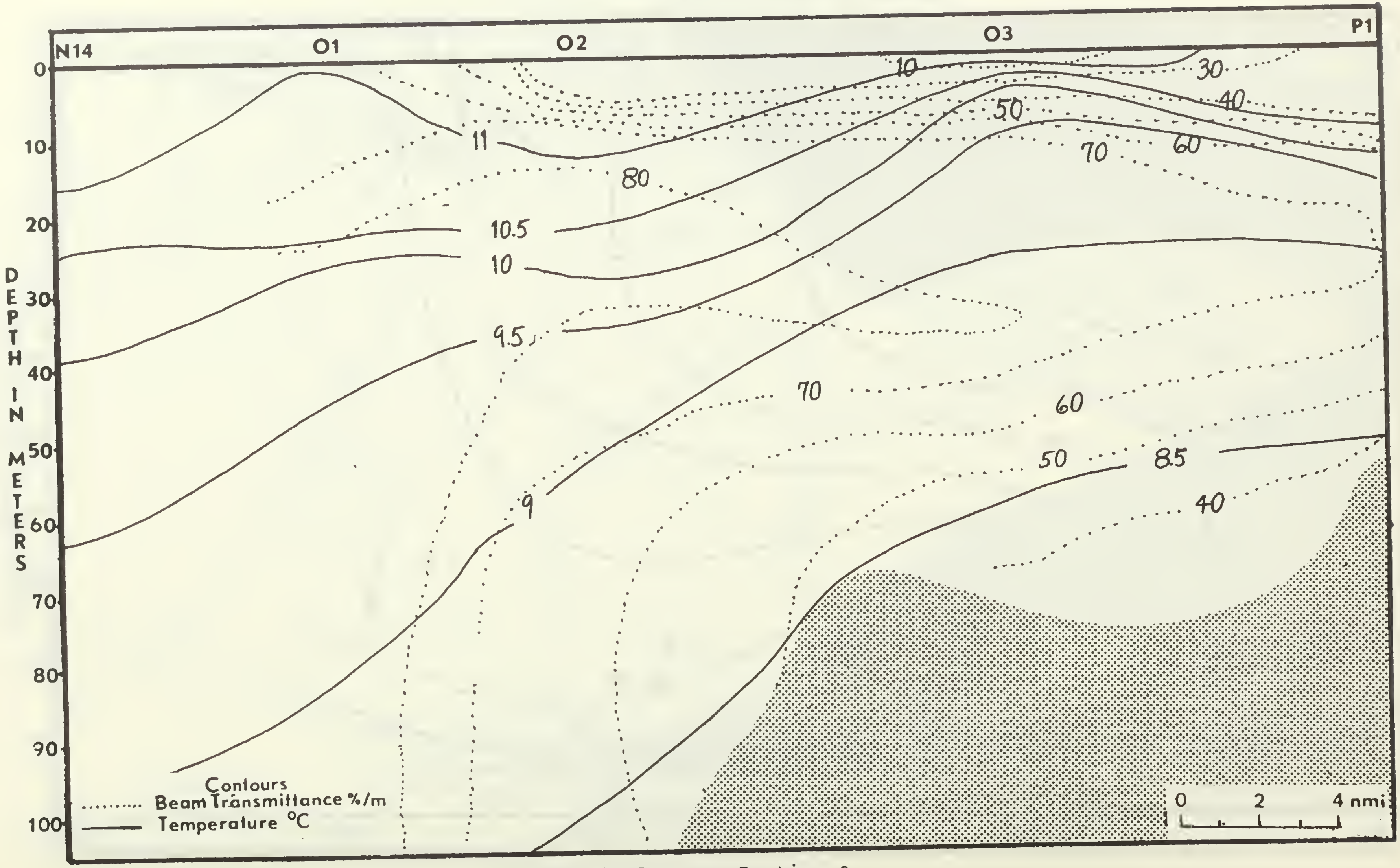
Vertical Cross Section 8

Temperature in Relation to Coulter Count



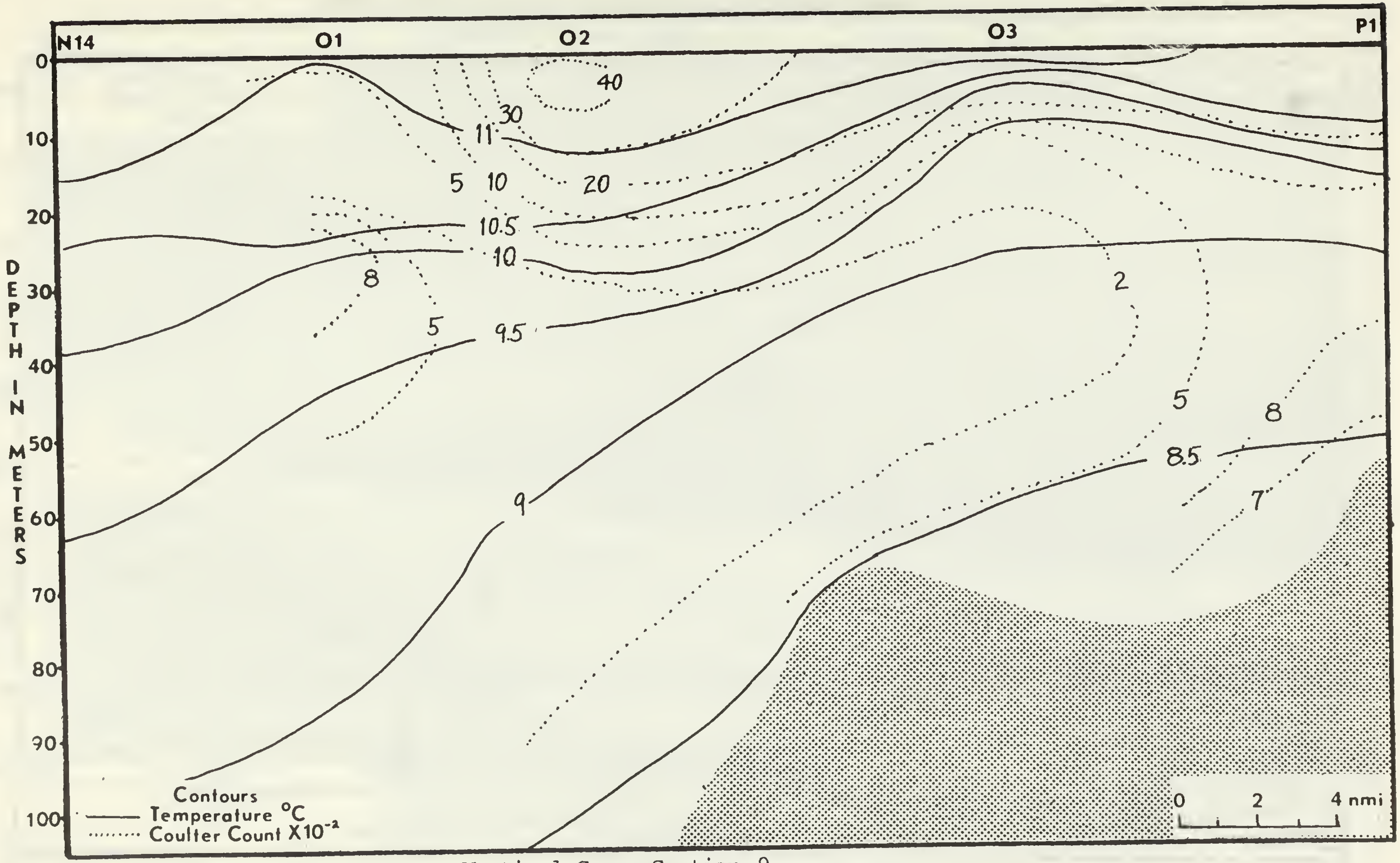
Vertical Cross Section 9

Beam Transmittance in Relation to Coulter Count



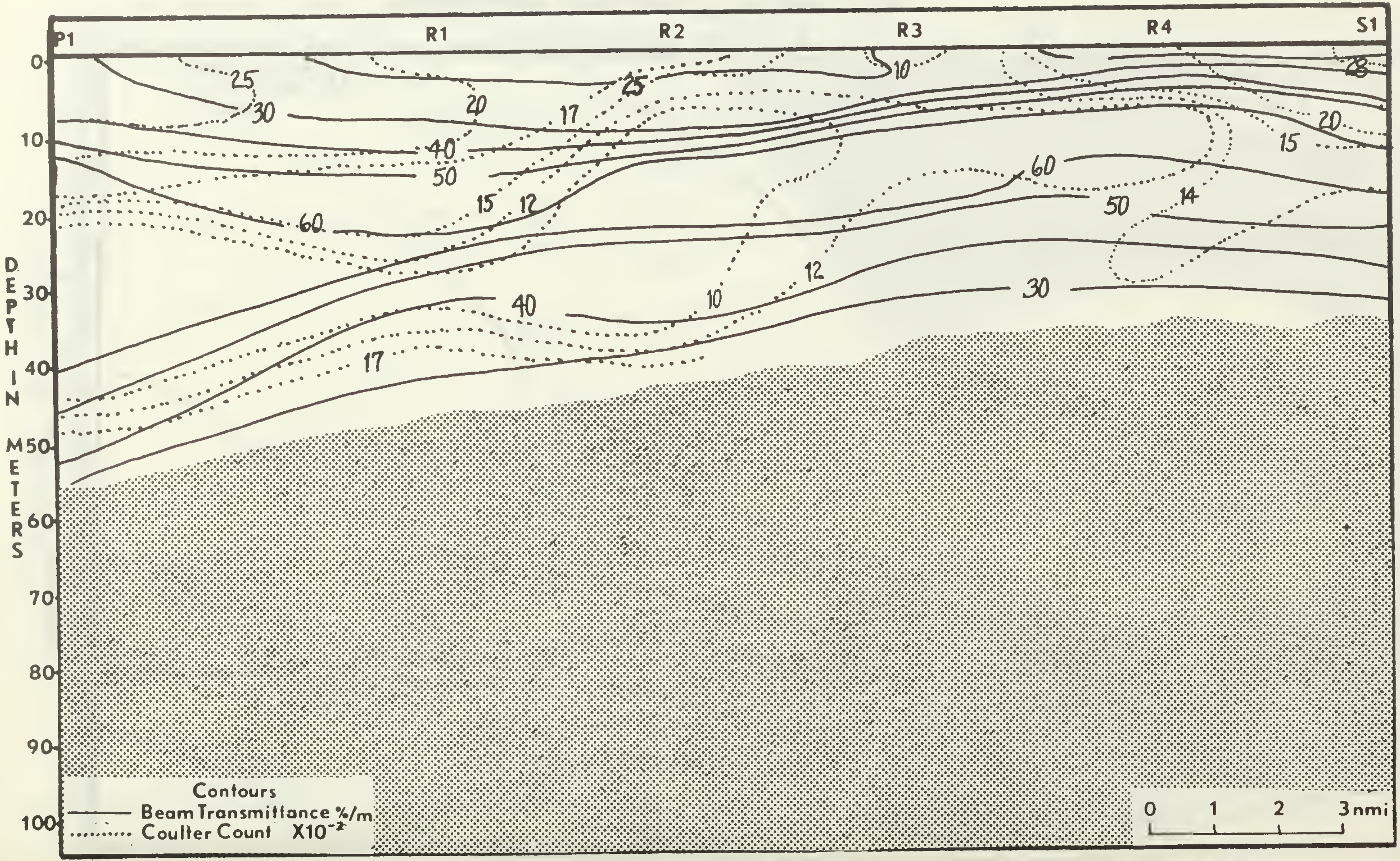
Vertical Cross Section 9

Beam Transmittance in Relation to Temperature



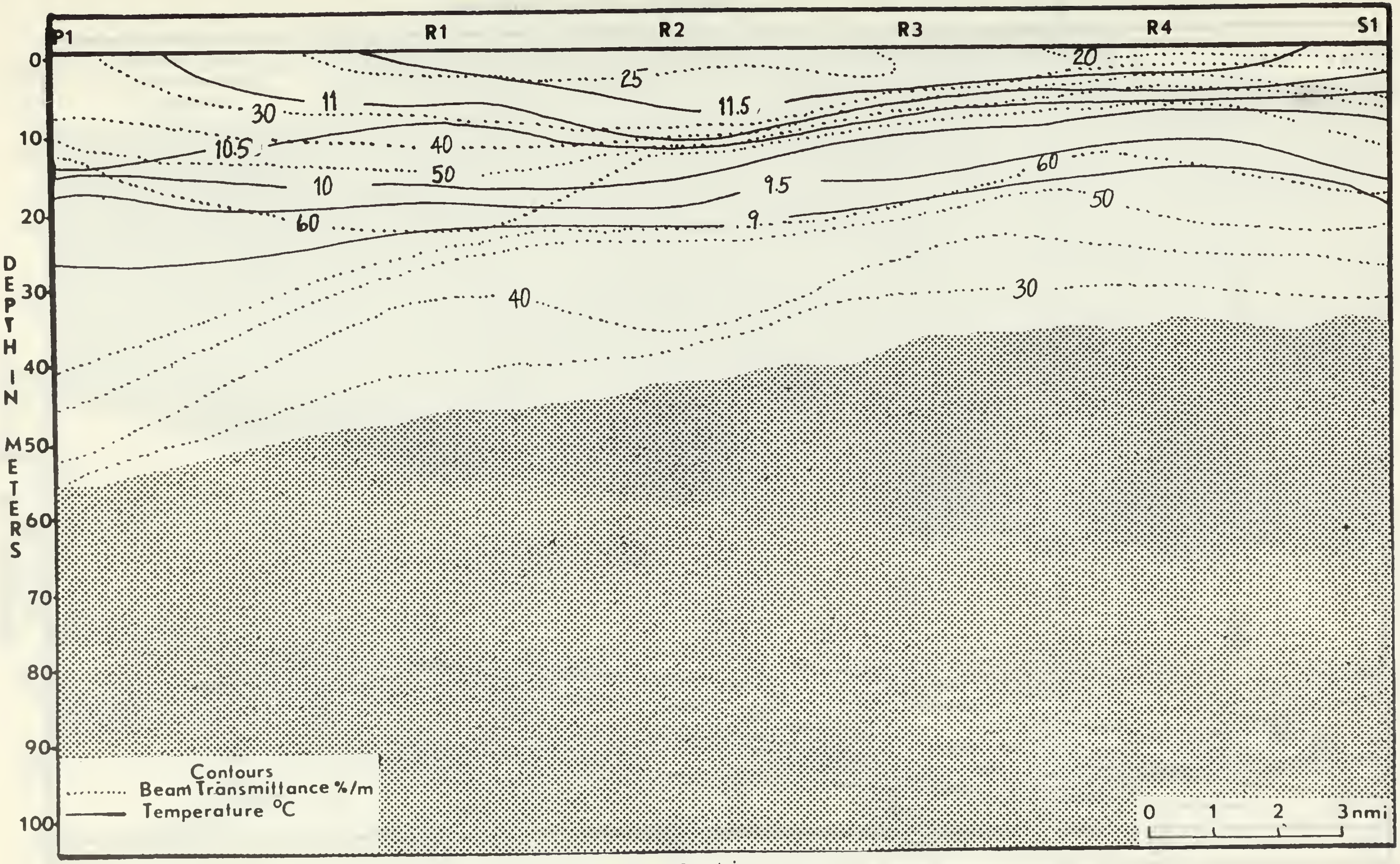
Vertical Cross Section 9

Temperature in Relation to Coulter Count



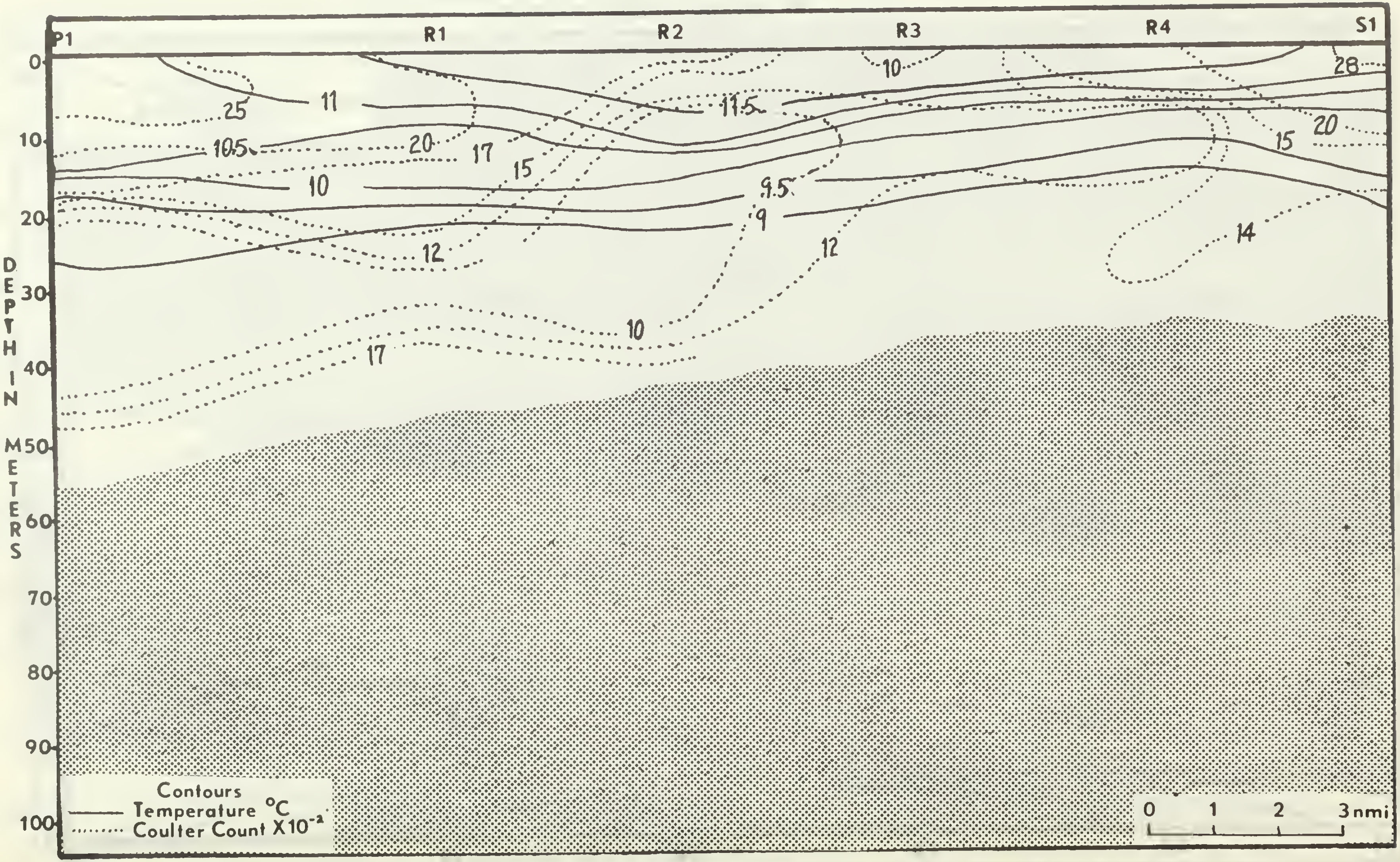
Vertical Cross Section 10

Beam Transmittance in Relation to Coulter Count



Vertical Cross Section 10

Beam Transmittance in Relation to Temperature

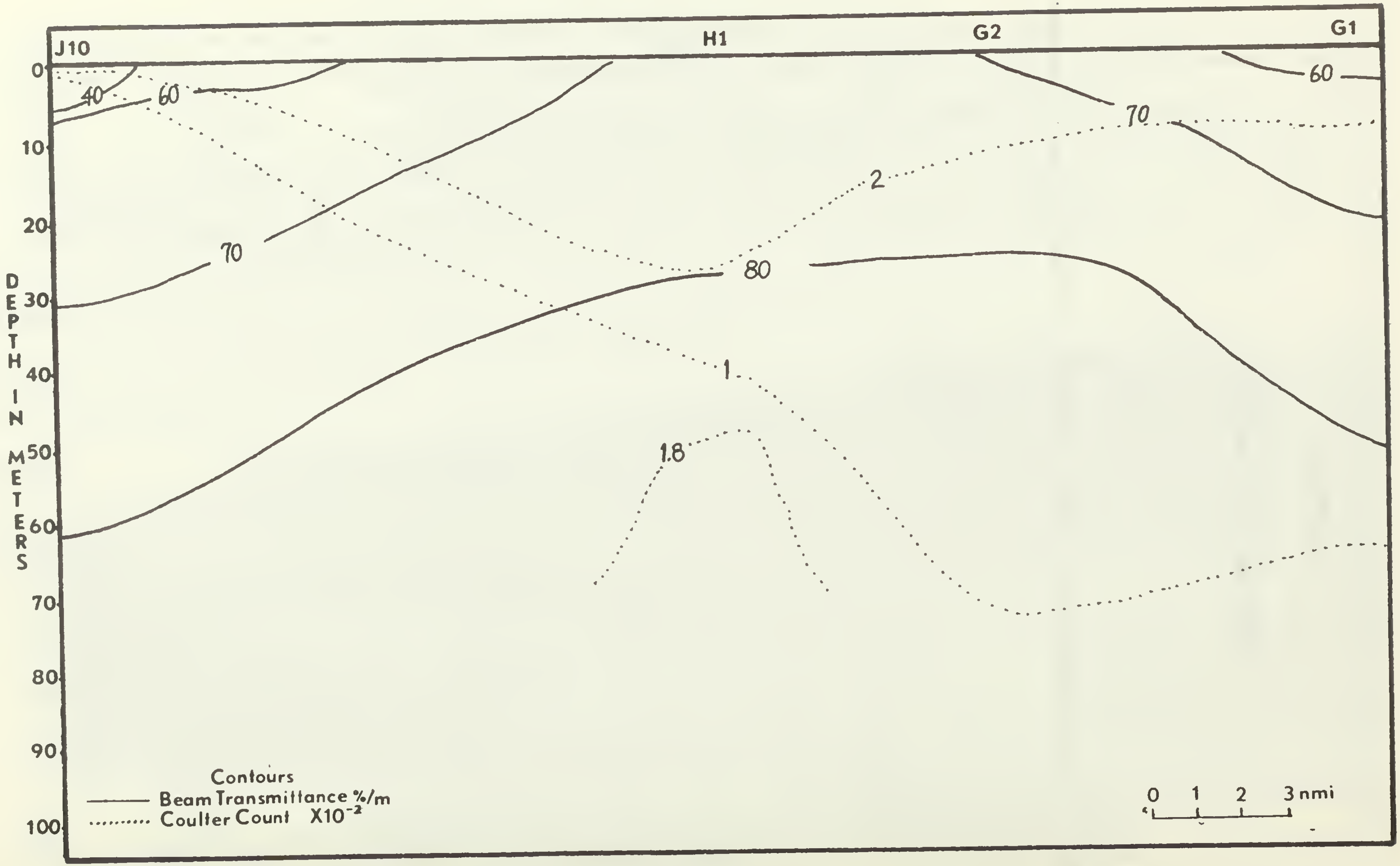


Vertical Cross Section '0
Temperature in Relation to Coulter Count

APPENDIX C2

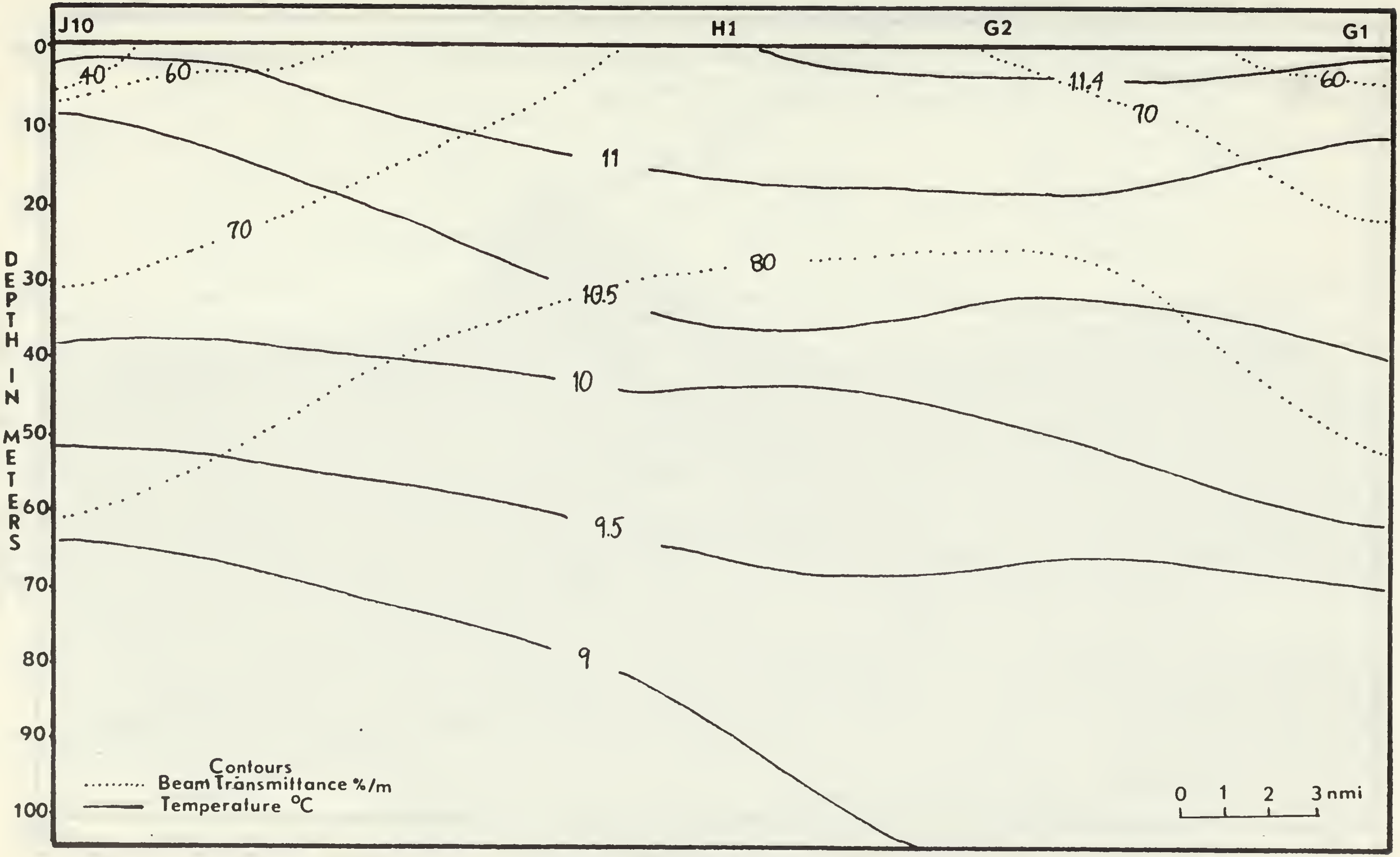
PARALLEL CROSS SECTIONS

NOTE: In this APPENDIX the contour intervals are not strictly constant.



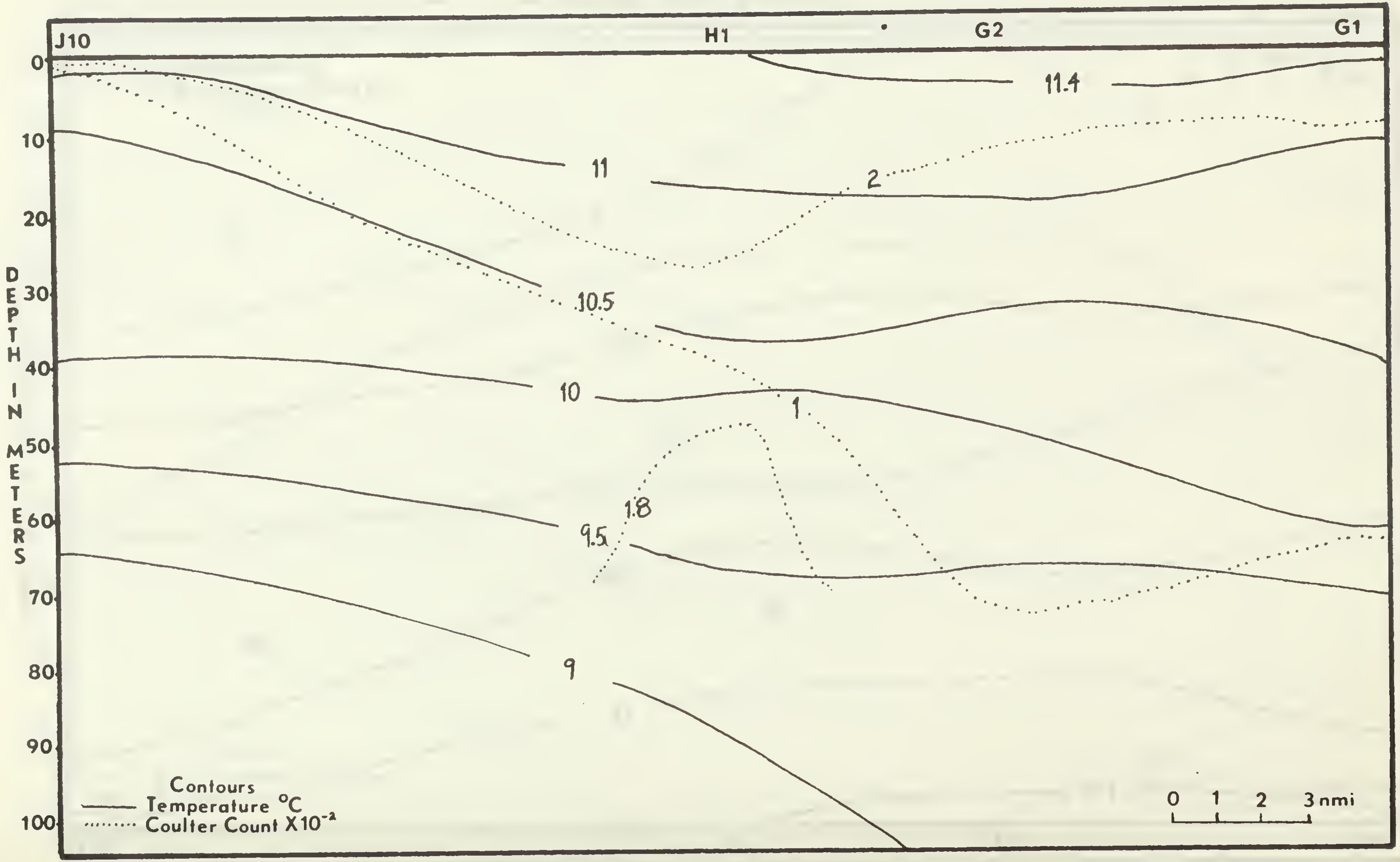
Vertical Cross Section 3

Beam Transmittance in Relation to Coulter Count



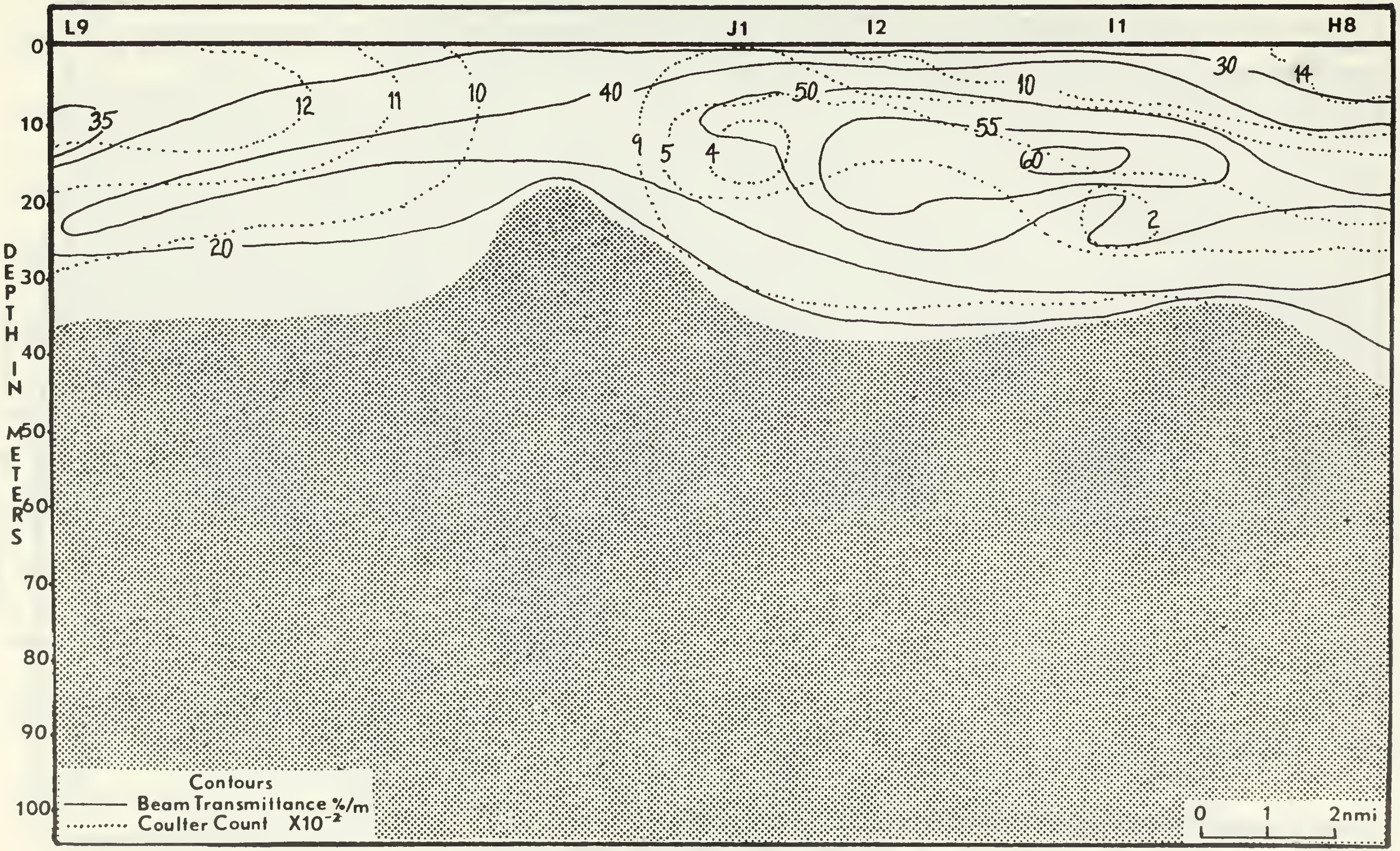
Vertical Cross Section 3

Beam Transmittance in Relation to Temperature



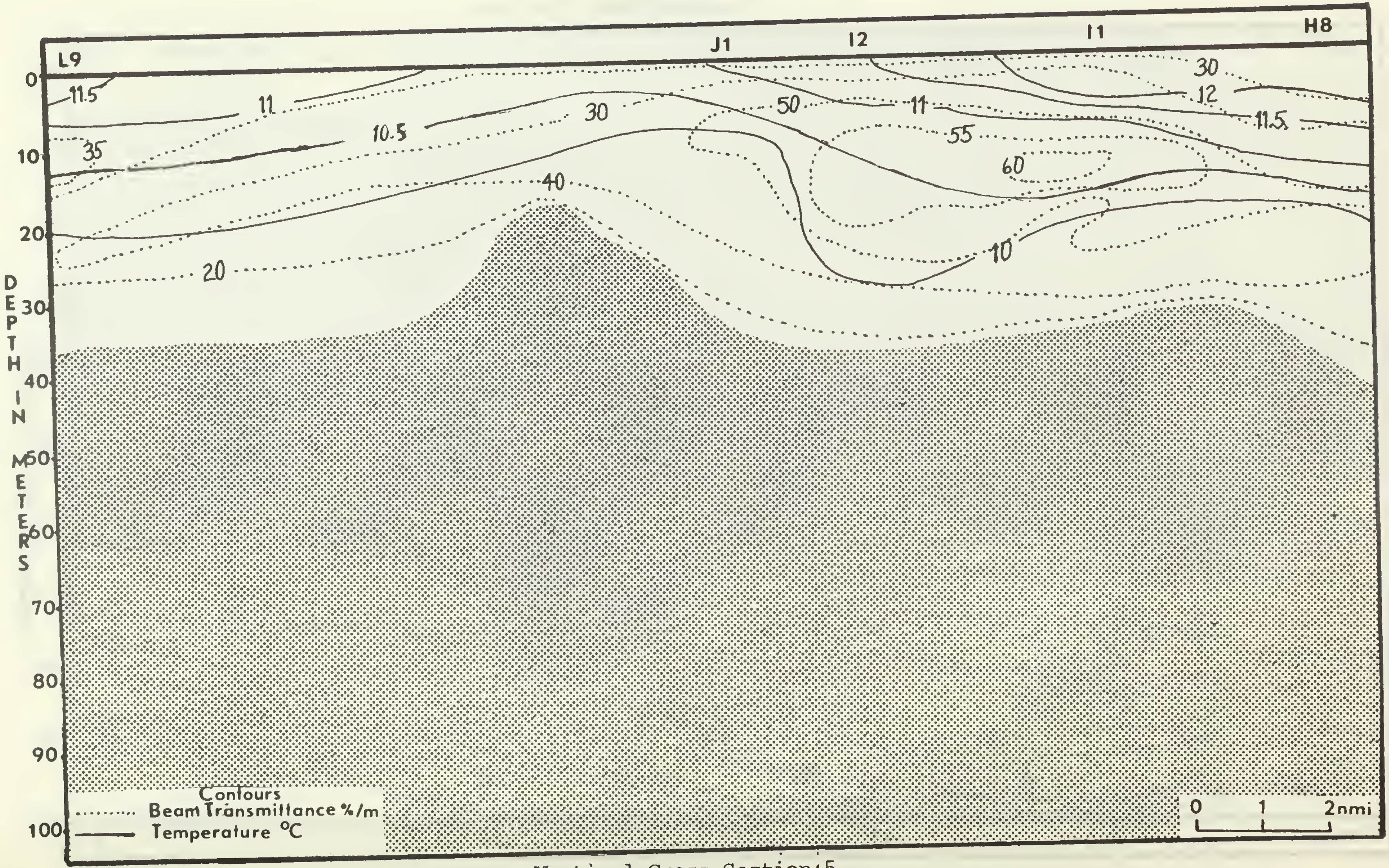
Vertical Cross Section 3

Temperature in Relation to Coulter Count



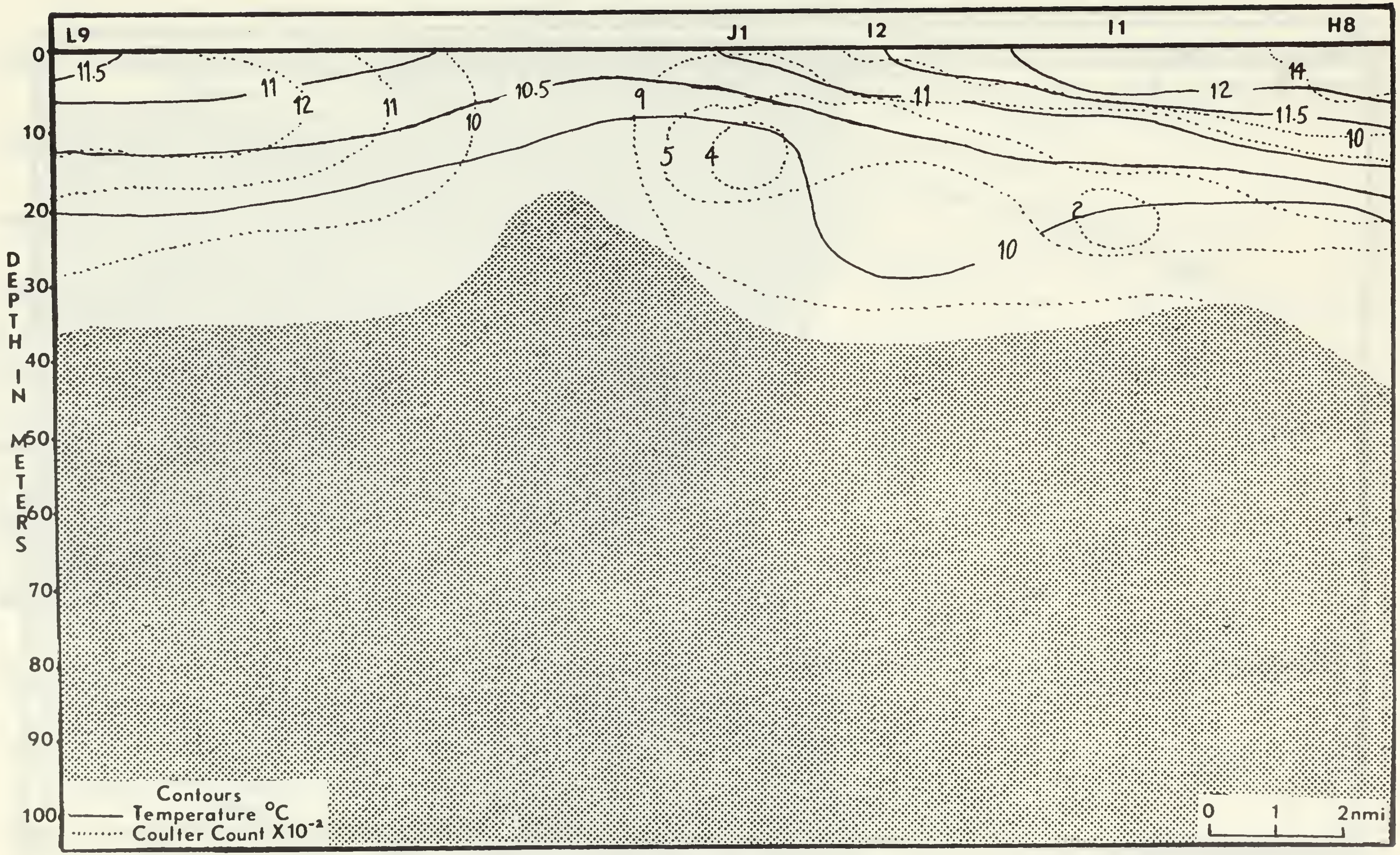
Vertical Cross Section 5

Beam Transmittance in Relation to Coulter Count



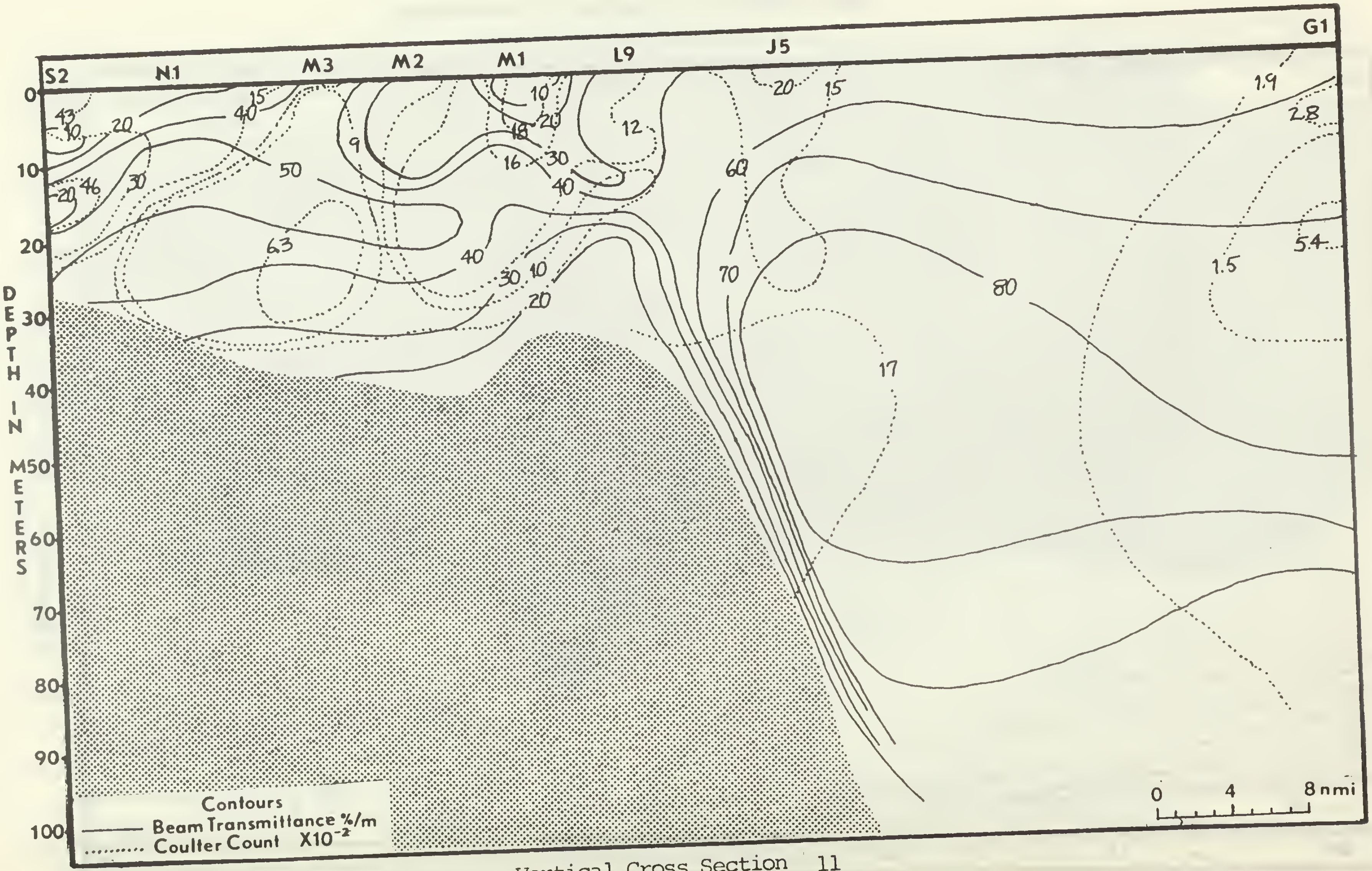
Vertical Cross Section 5

Beam Transmittance in Relation to Temperature



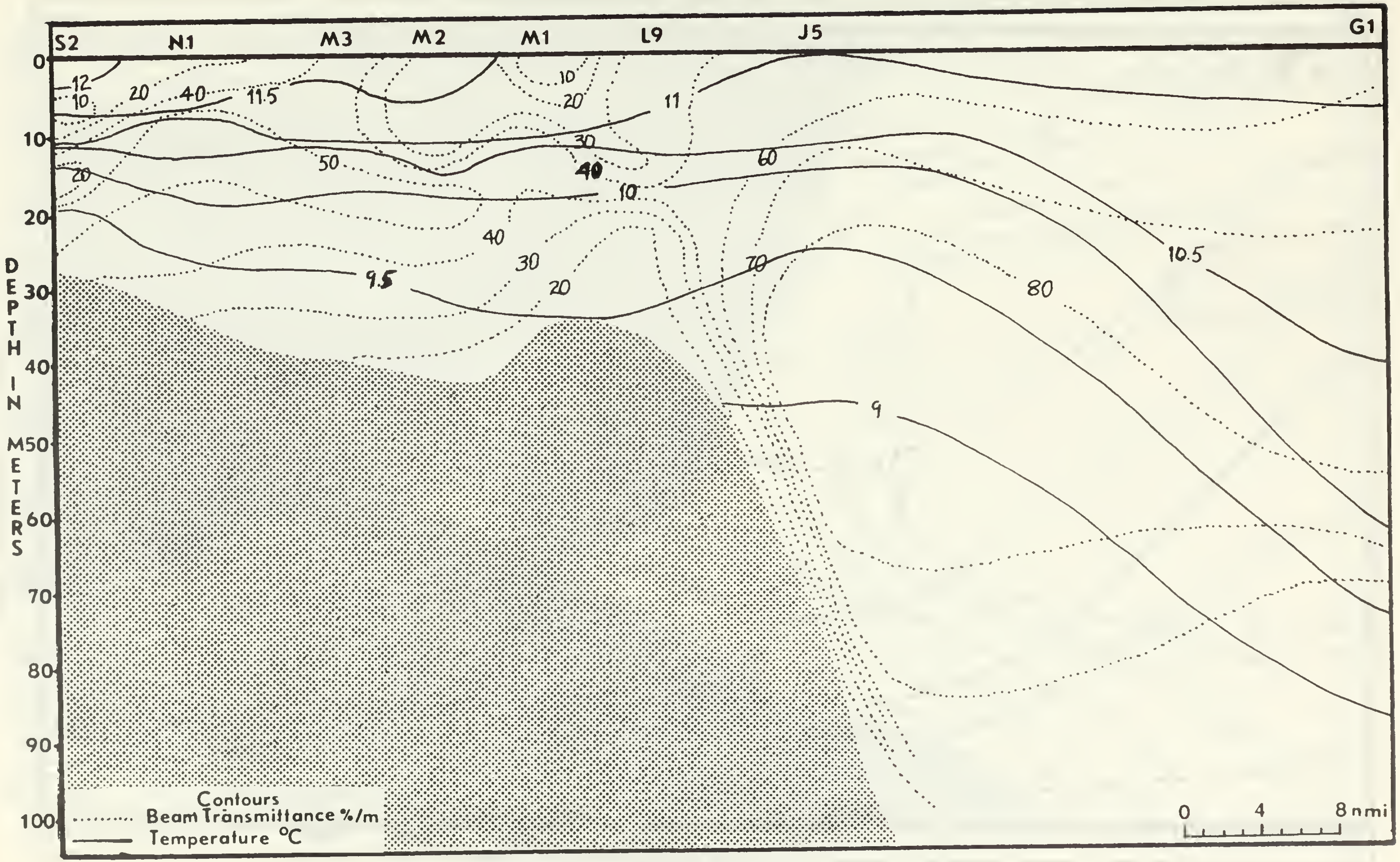
Vertical Cross Section 5

Temperature in Relation to Coulter Count

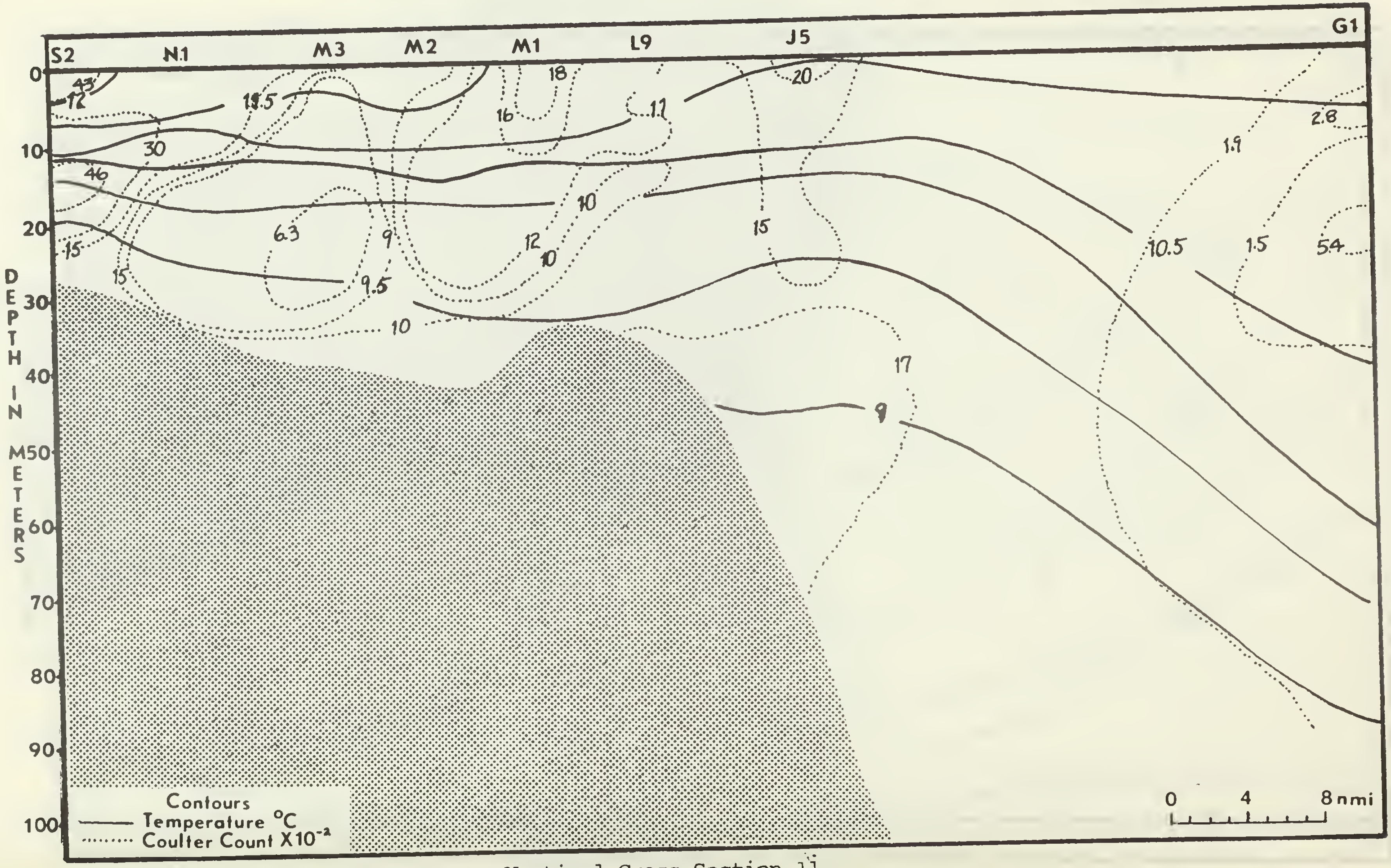


Vertical Cross Section 11

Beam Transmittance in Relation to Coulter Count

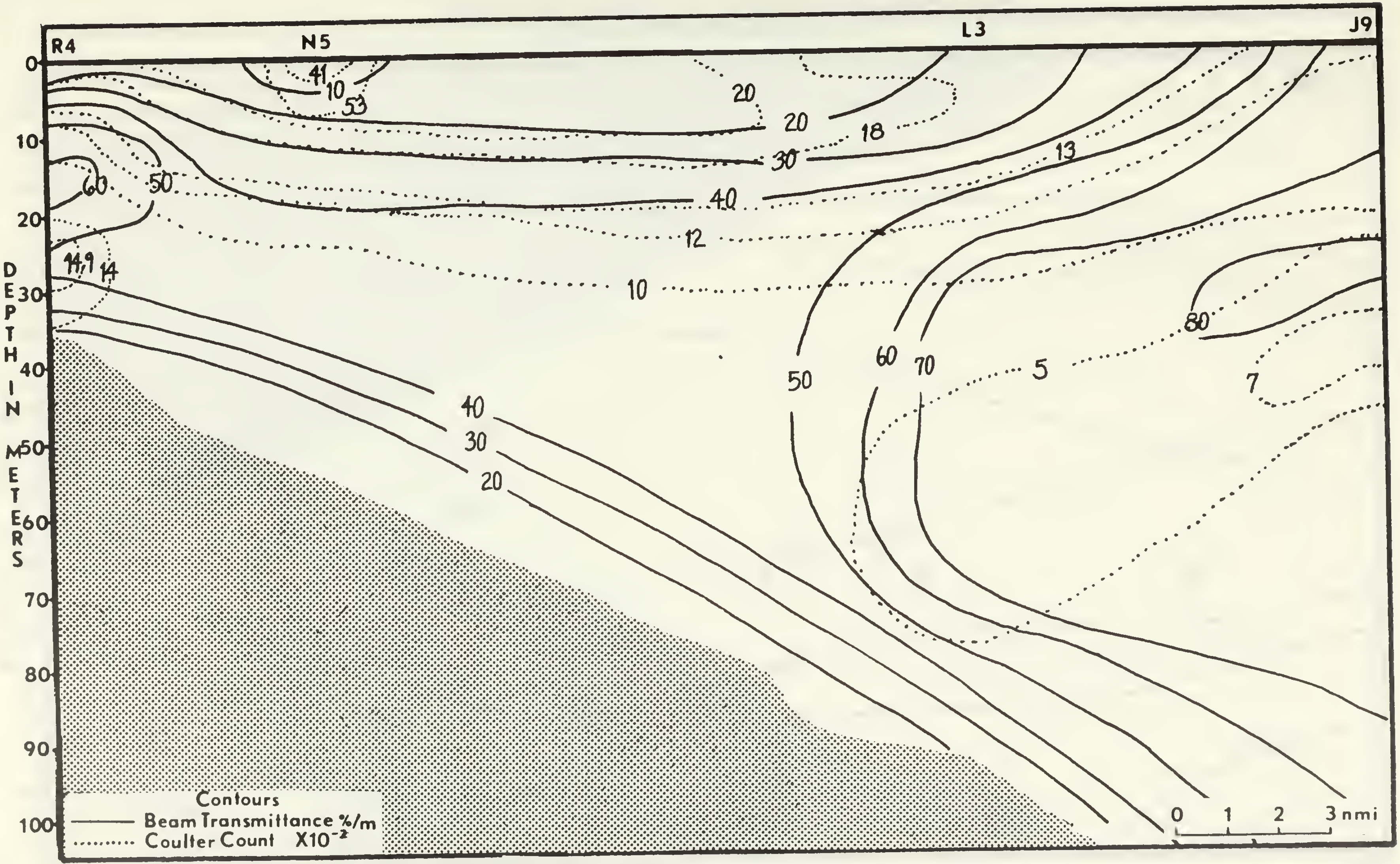


Vertical Cross Section 11
Beam Transmittance in Relation to Temperature



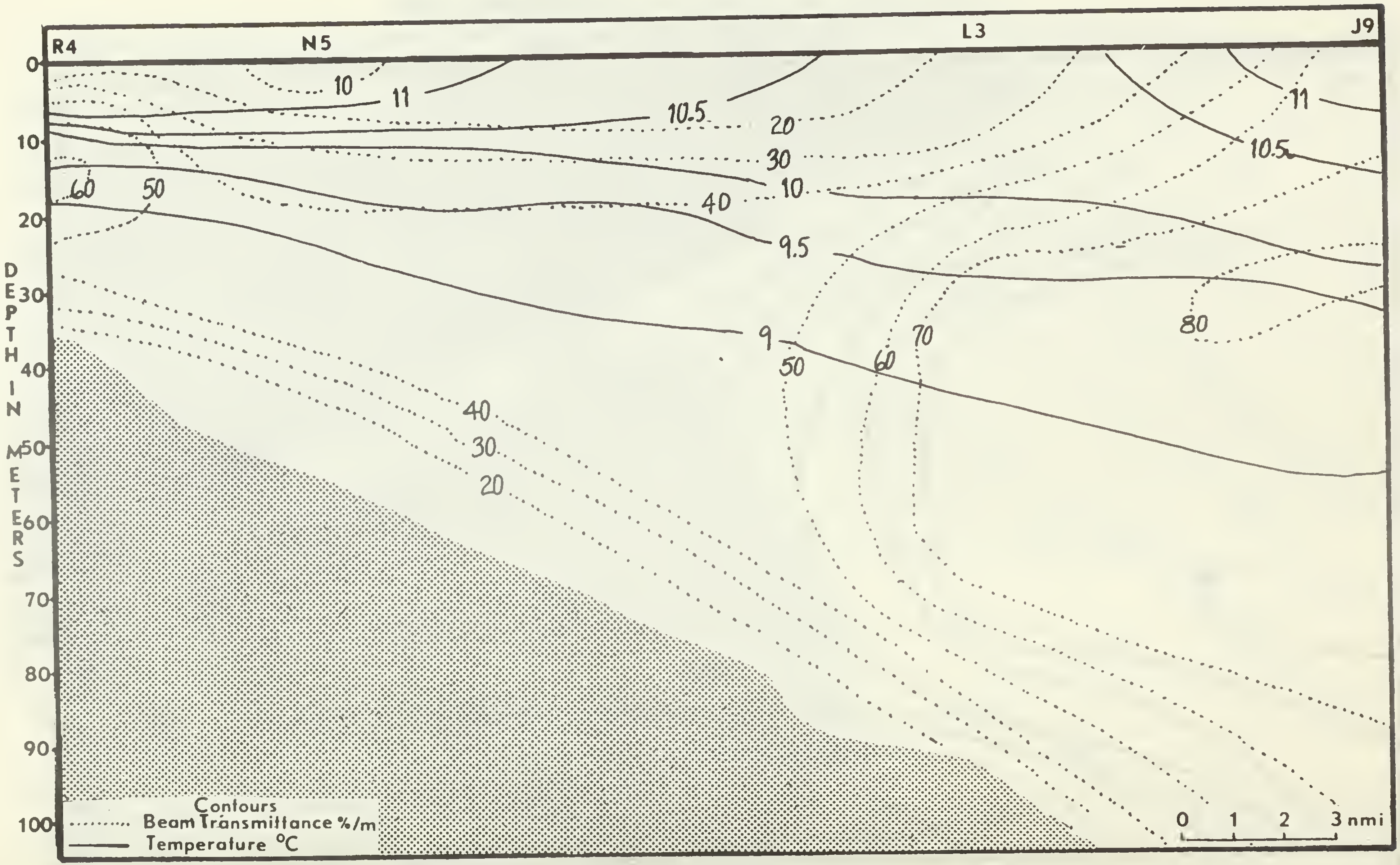
Vertical Cross Section 11

Temperature in Relation to Coulter Count

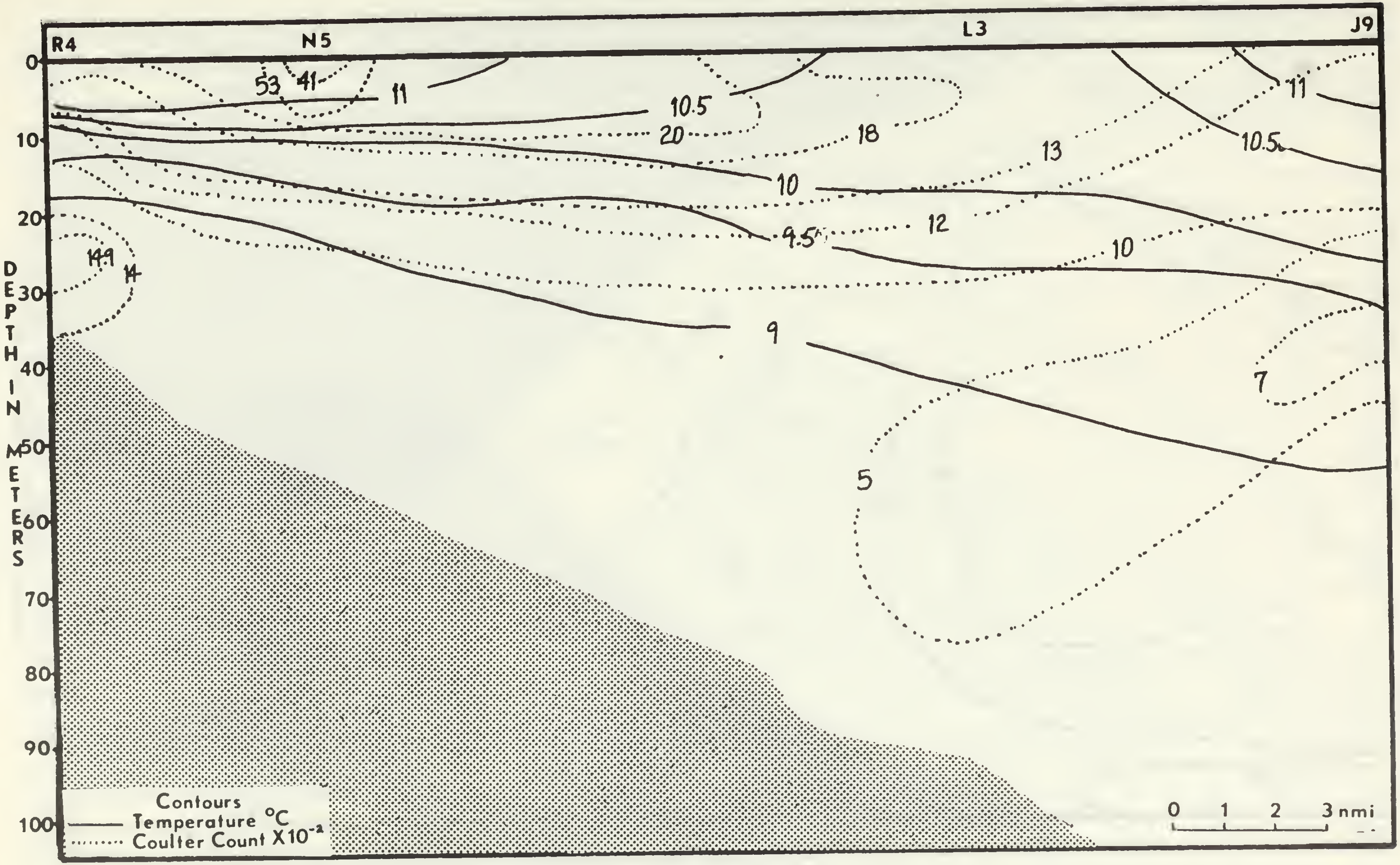


Vertical Cross Section 12

Beam Transmittance in Relation to Coulter Count

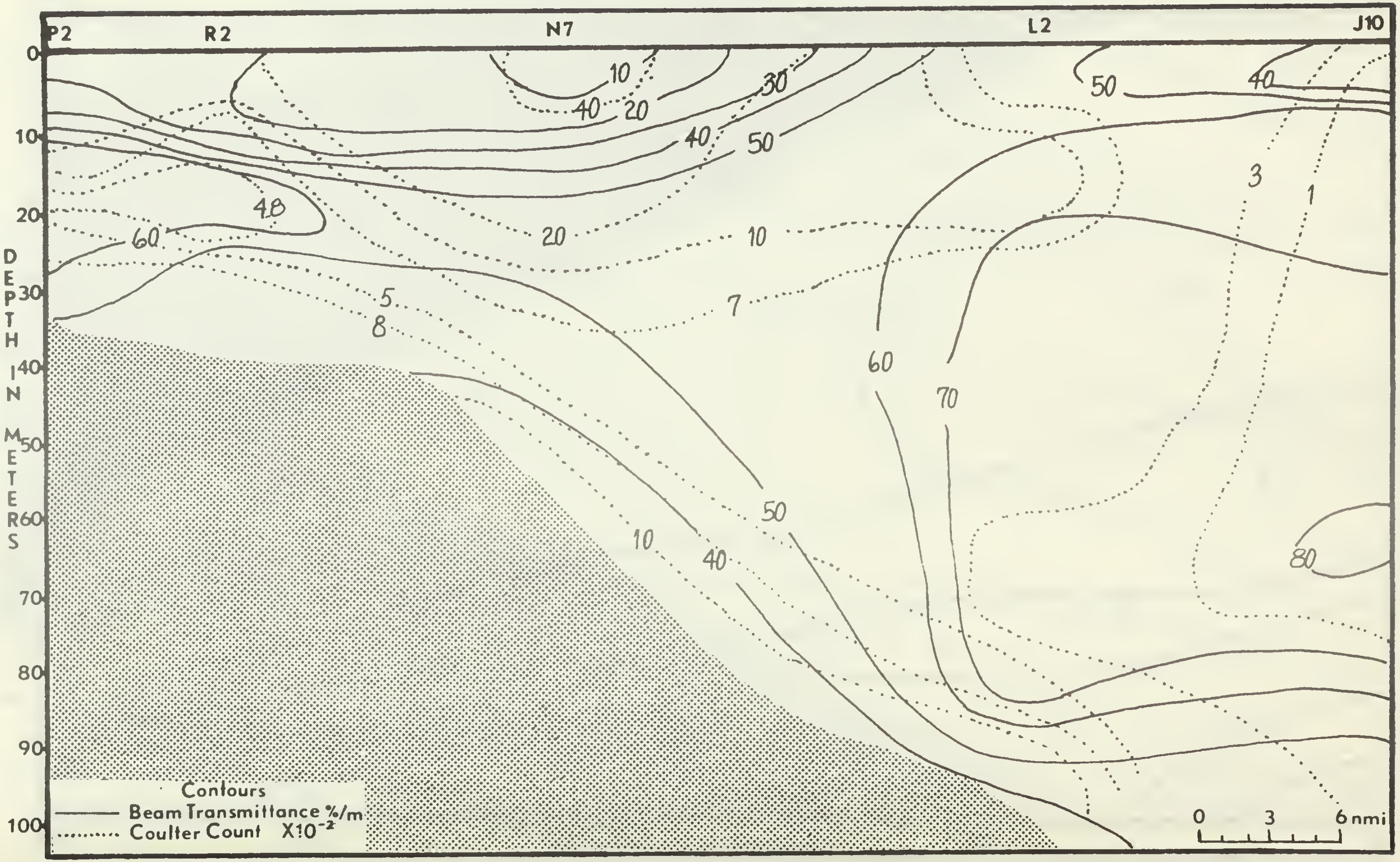


Vertical Cross Section 12
Beam Transmittance in Relation to Temperature



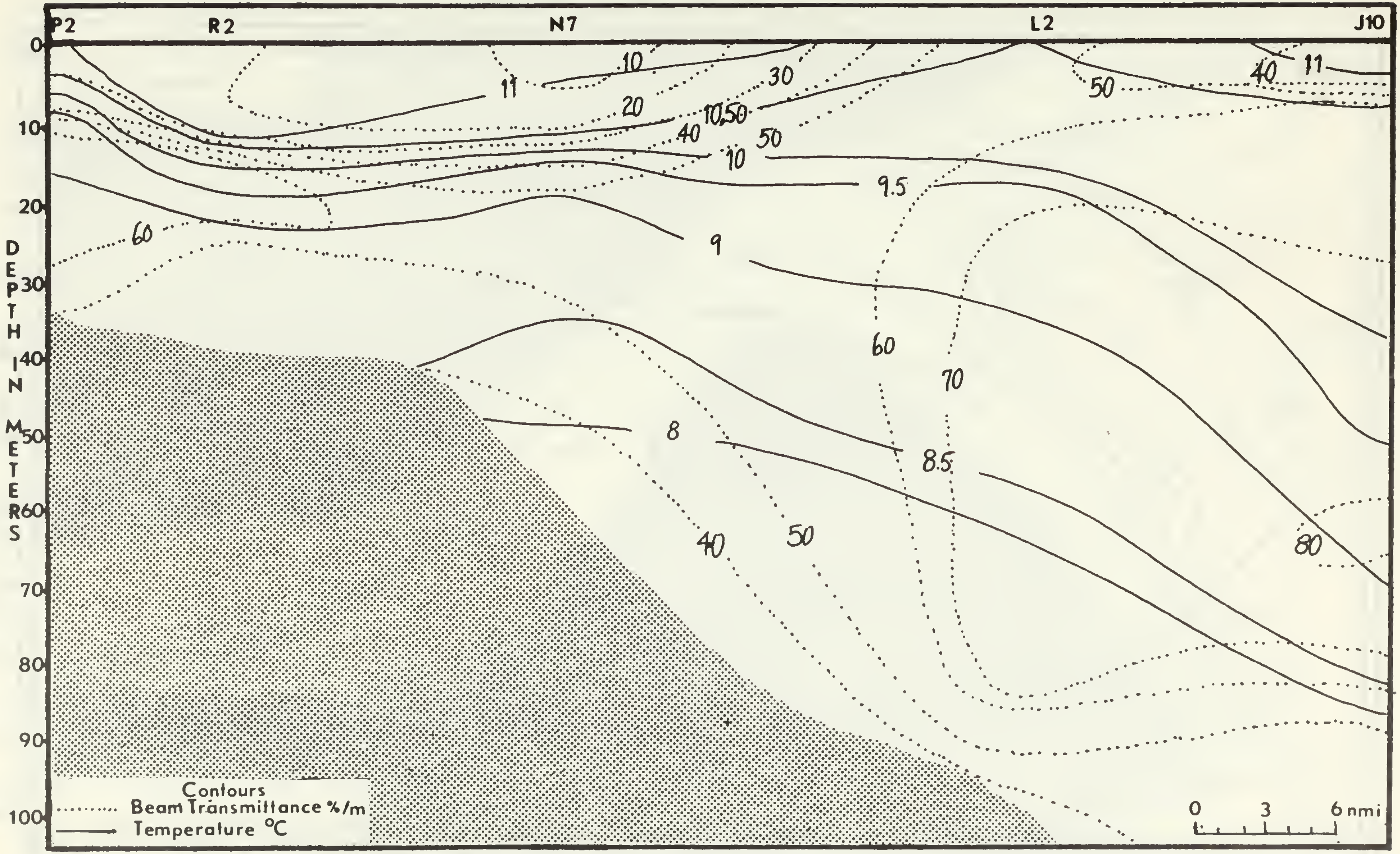
Vertical Cross Section 12

Temperature in Relation to Coulter Count



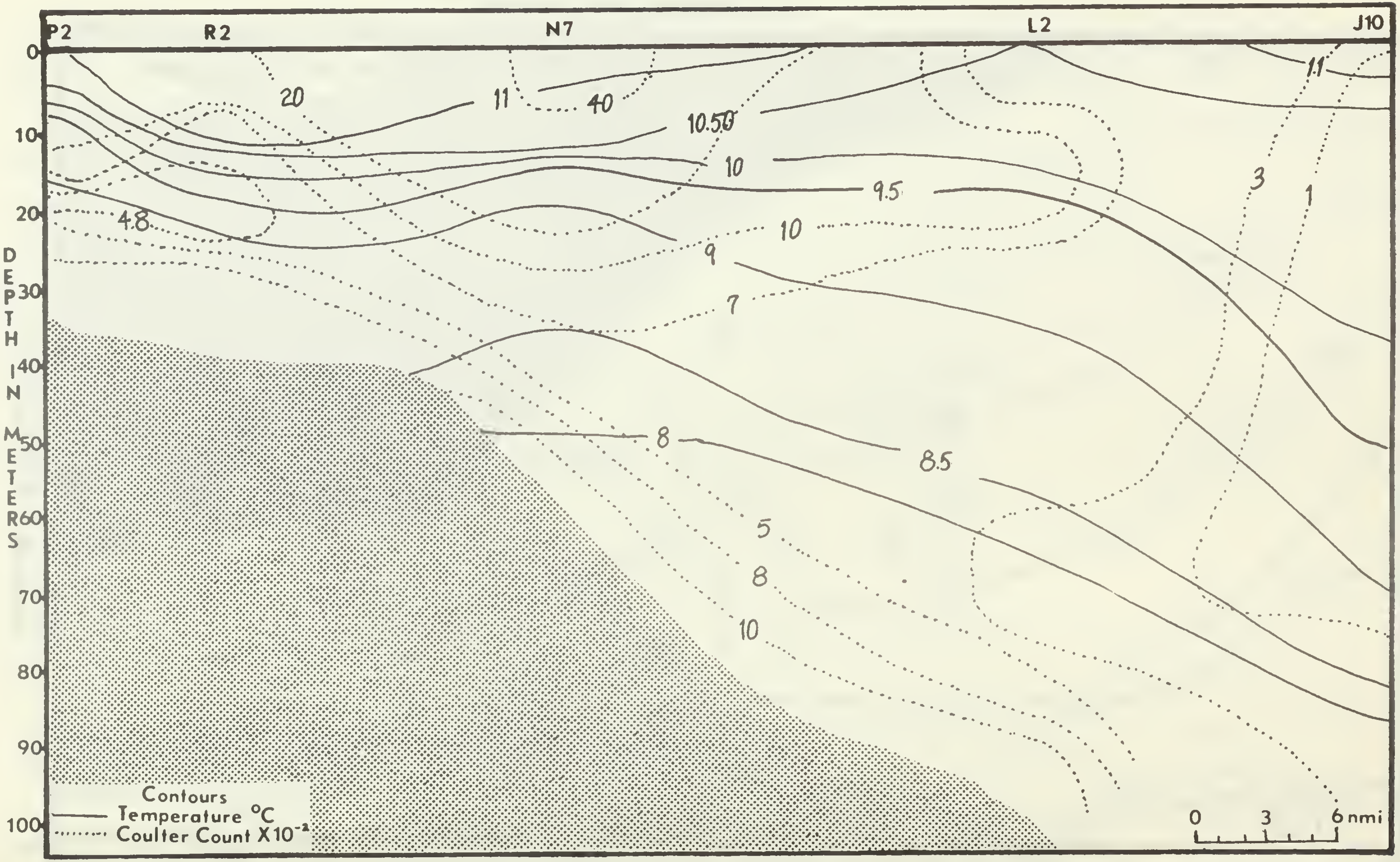
Vertical Cross Section 13

Beam Transmittance in Relation to Coulter Count

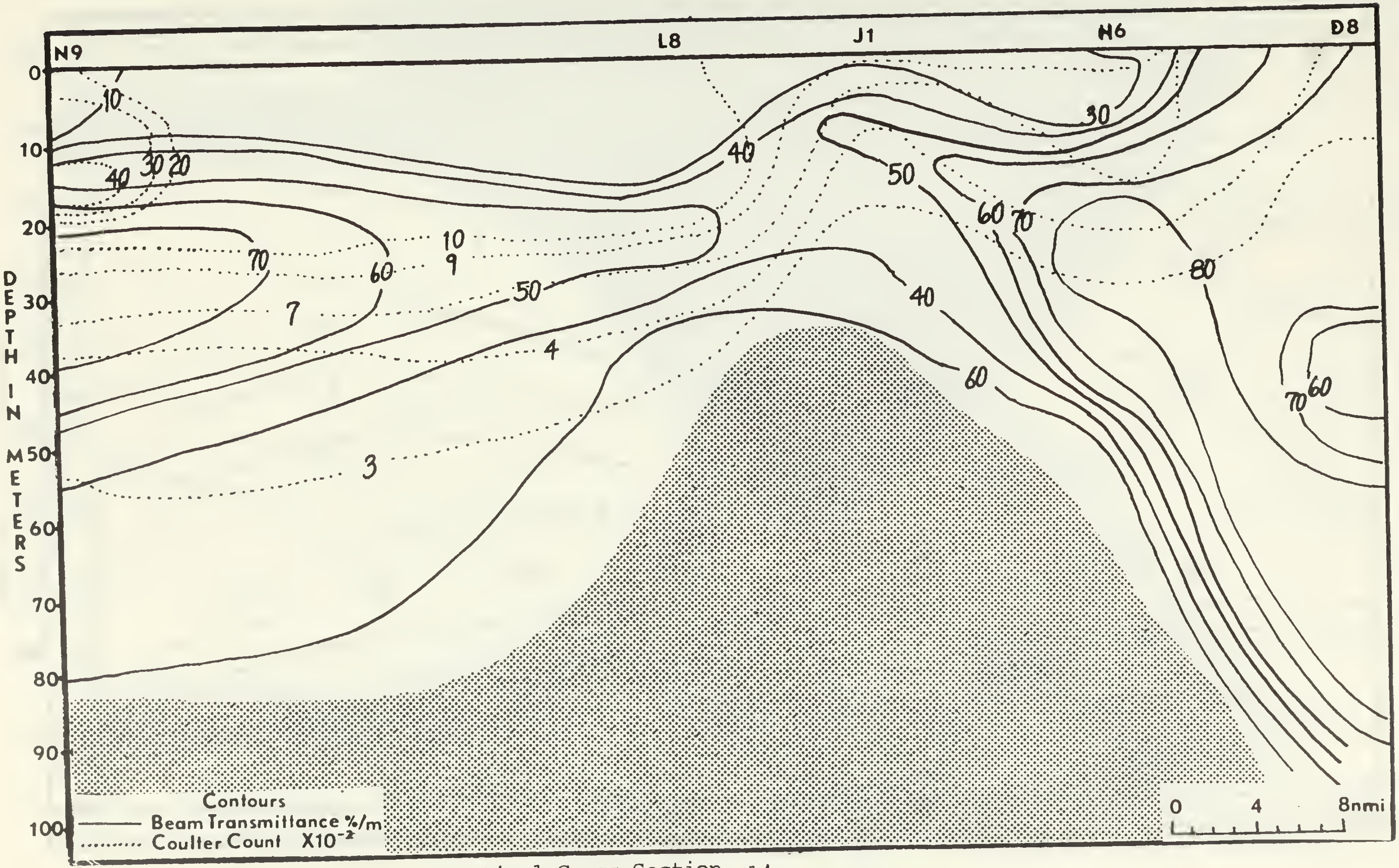


Vertical Cross Section 13

Beam Transmittance in Relation to Temperature

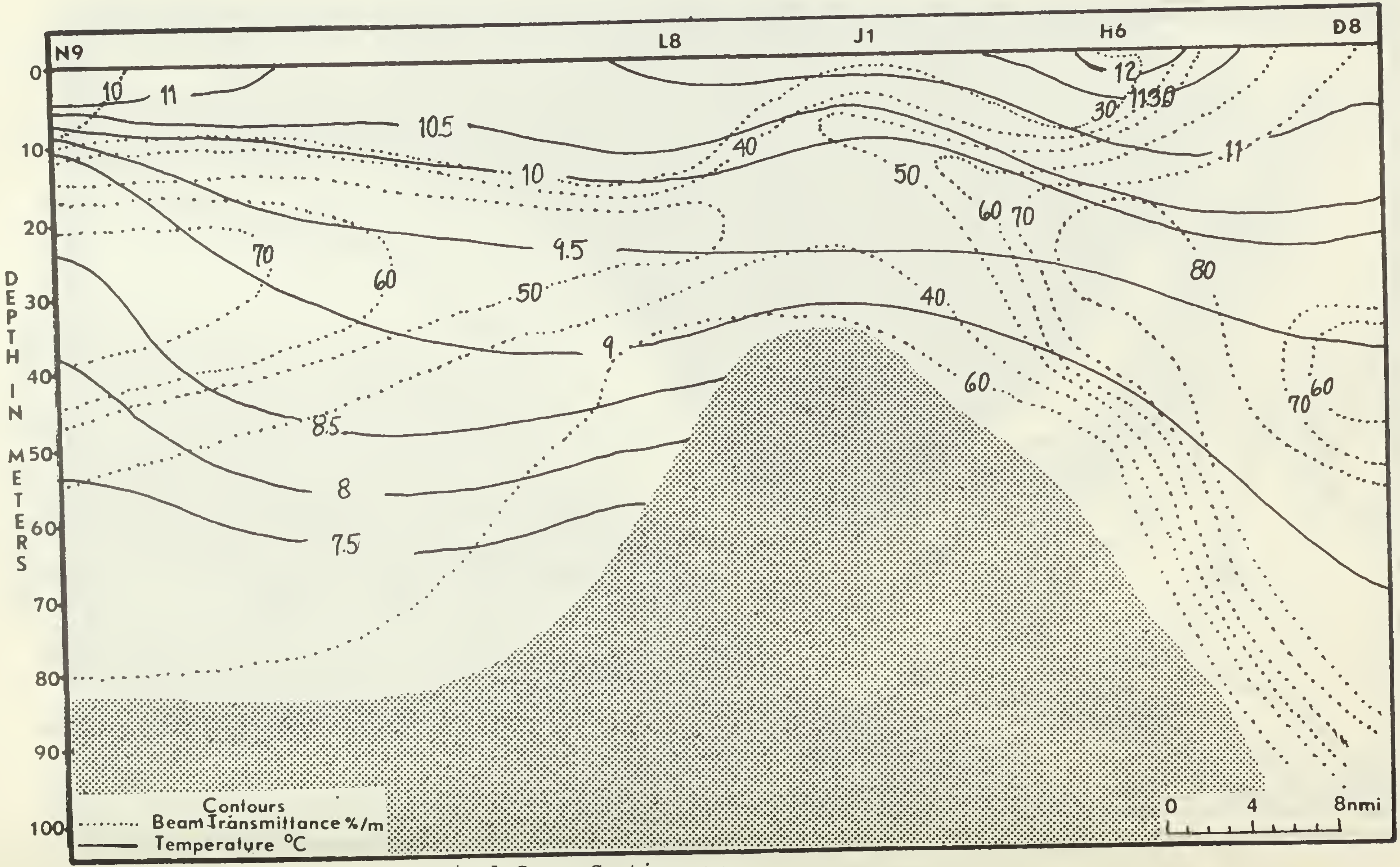


Vertical Cross Section 13
Temperature in Relation to Coulter Count



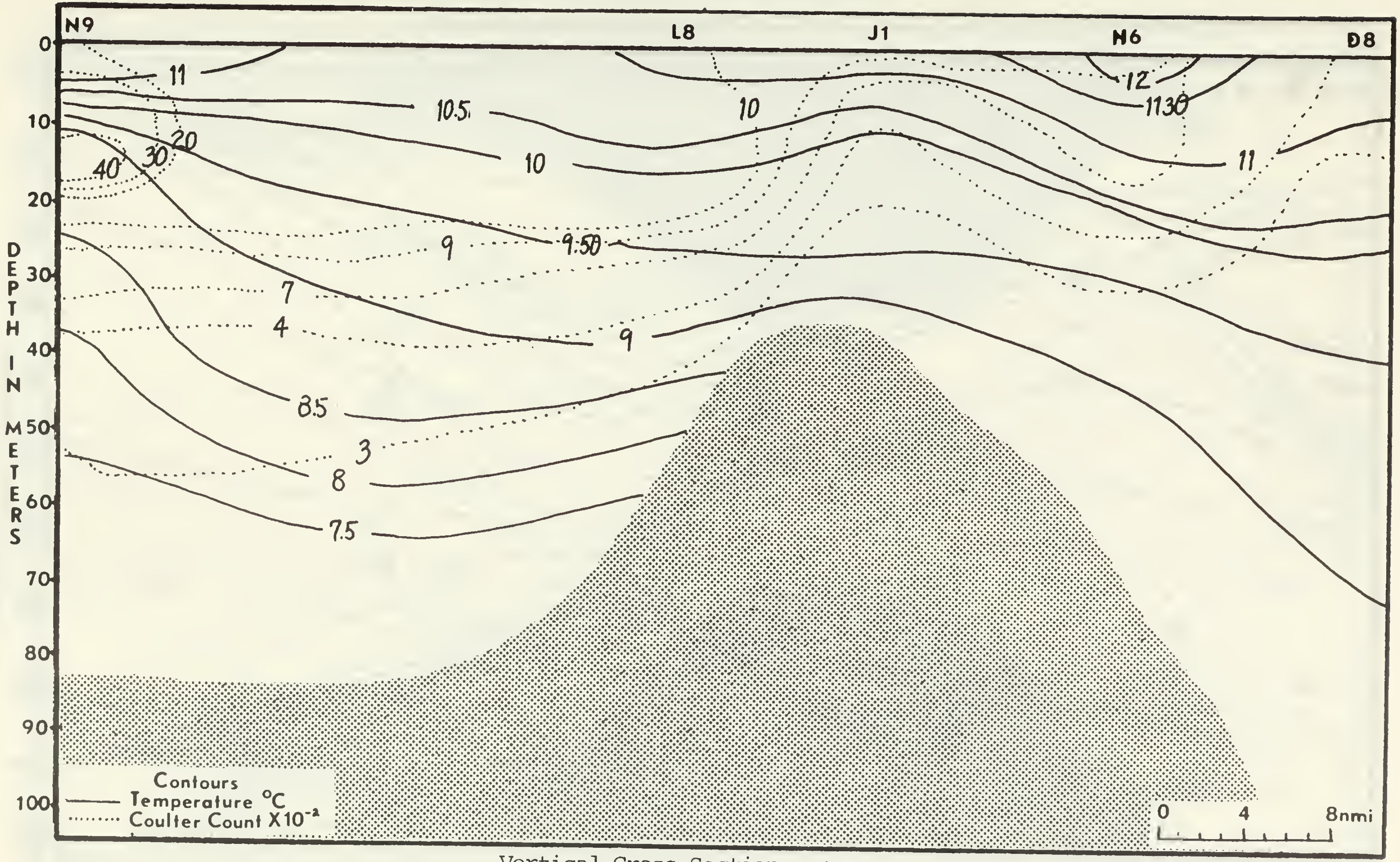
Vertical Cross Section 14

Beam Transmittance in Relation to Coulter Count



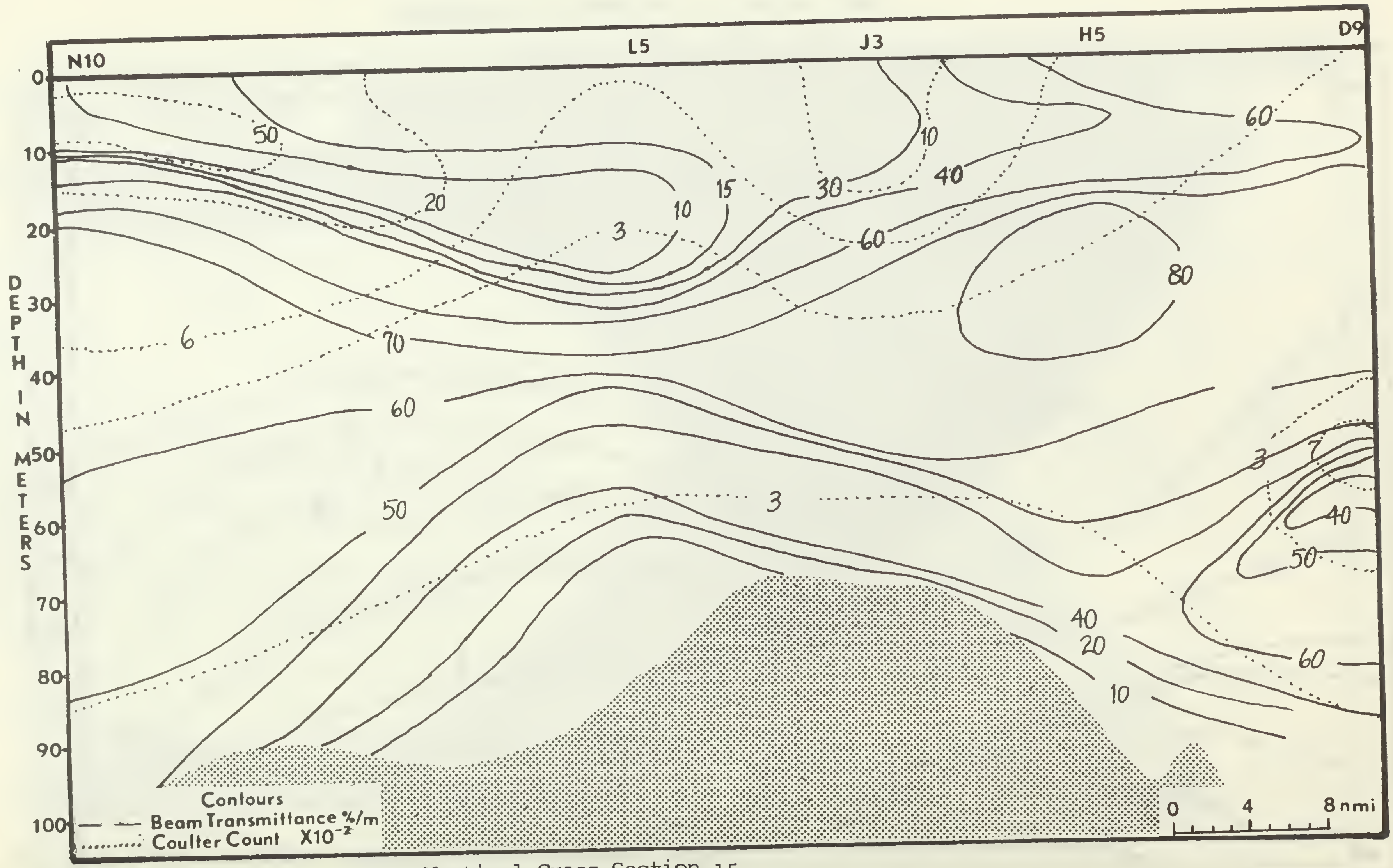
Vertical Cross Section 14

Beam Transmittance in Relation to Temperature



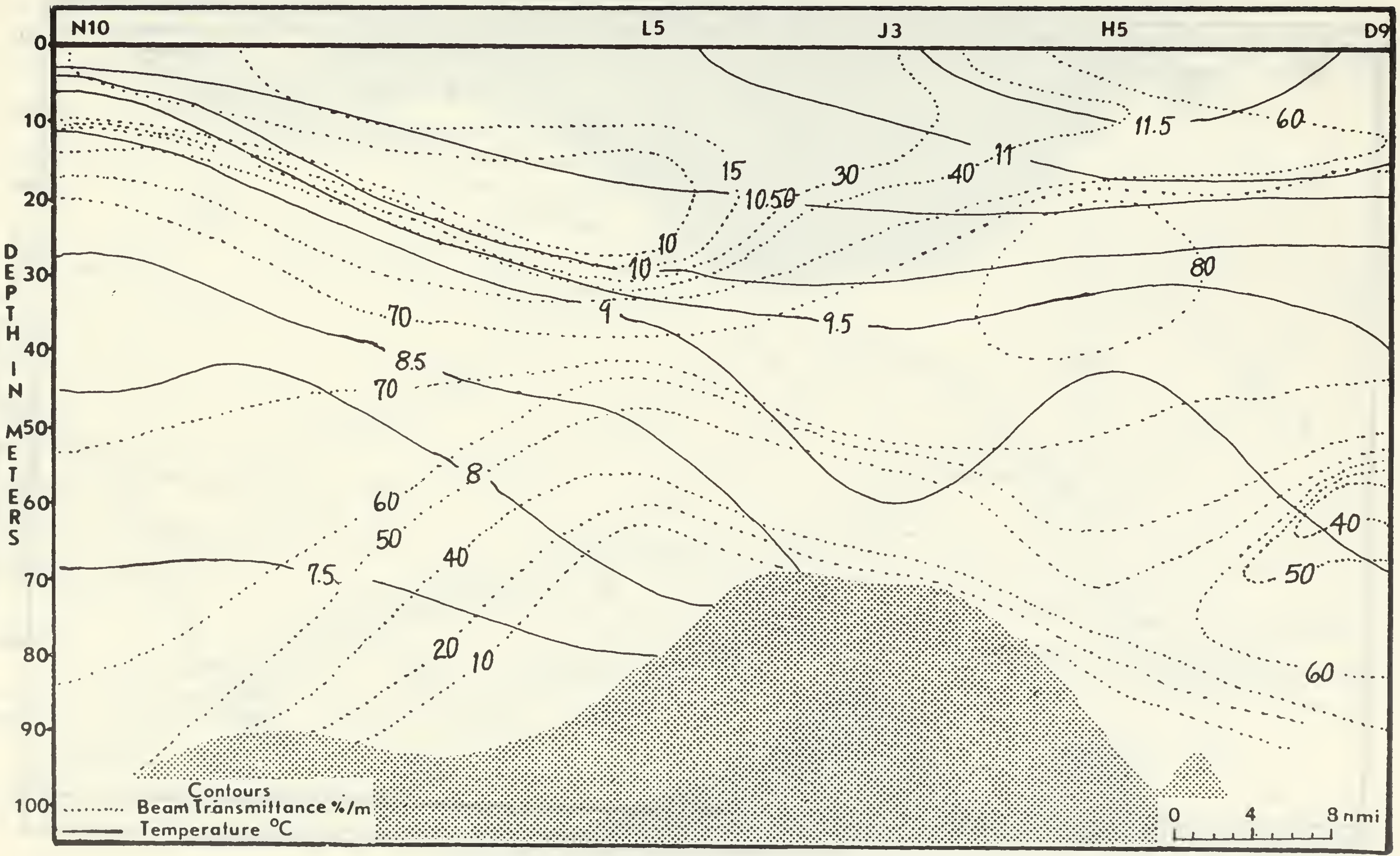
Vertical Cross Section 14

Temperature in Relation to Coulter Count



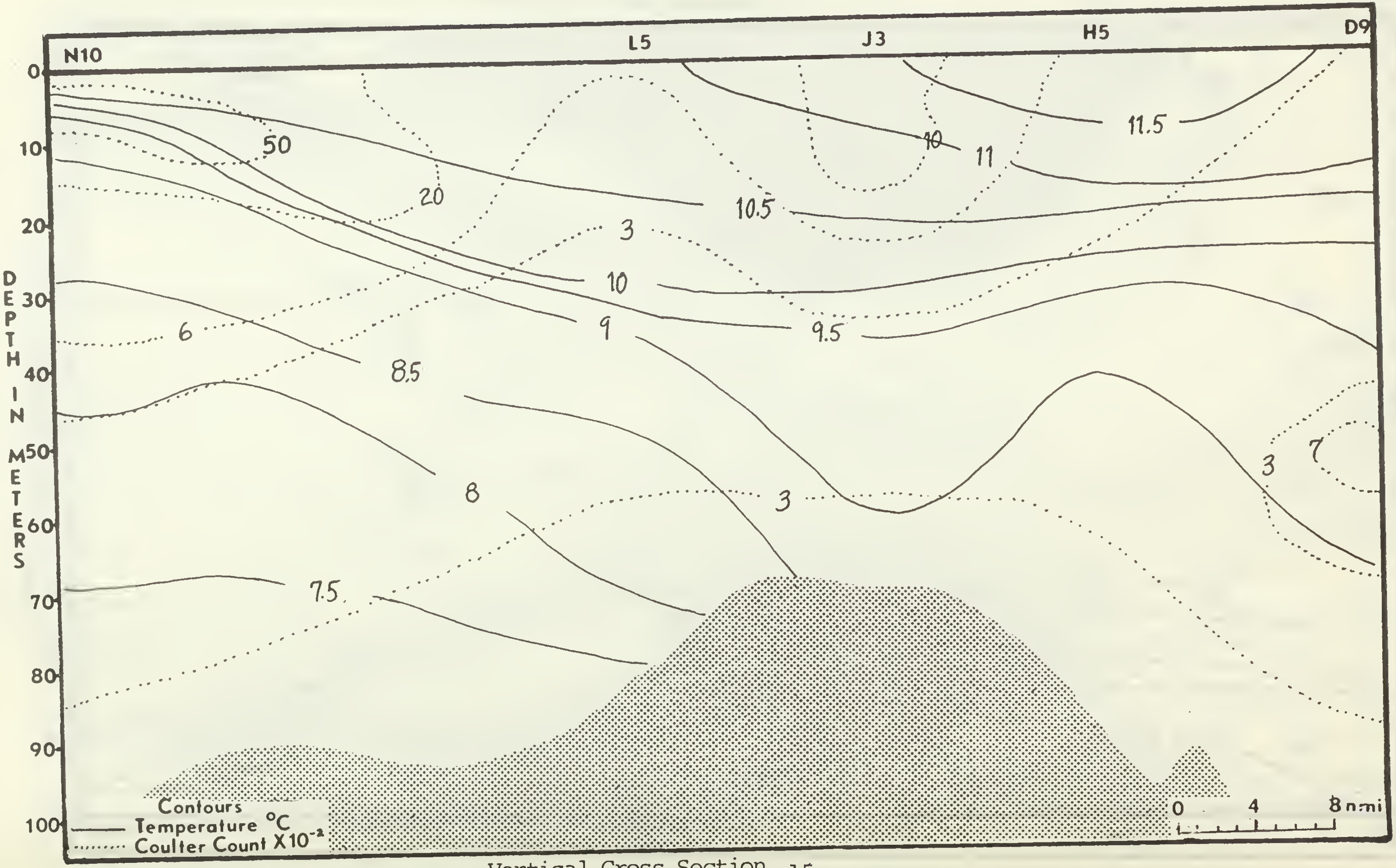
Vertical Cross Section 15

Beam Transmittance in Relation to Coulter Count

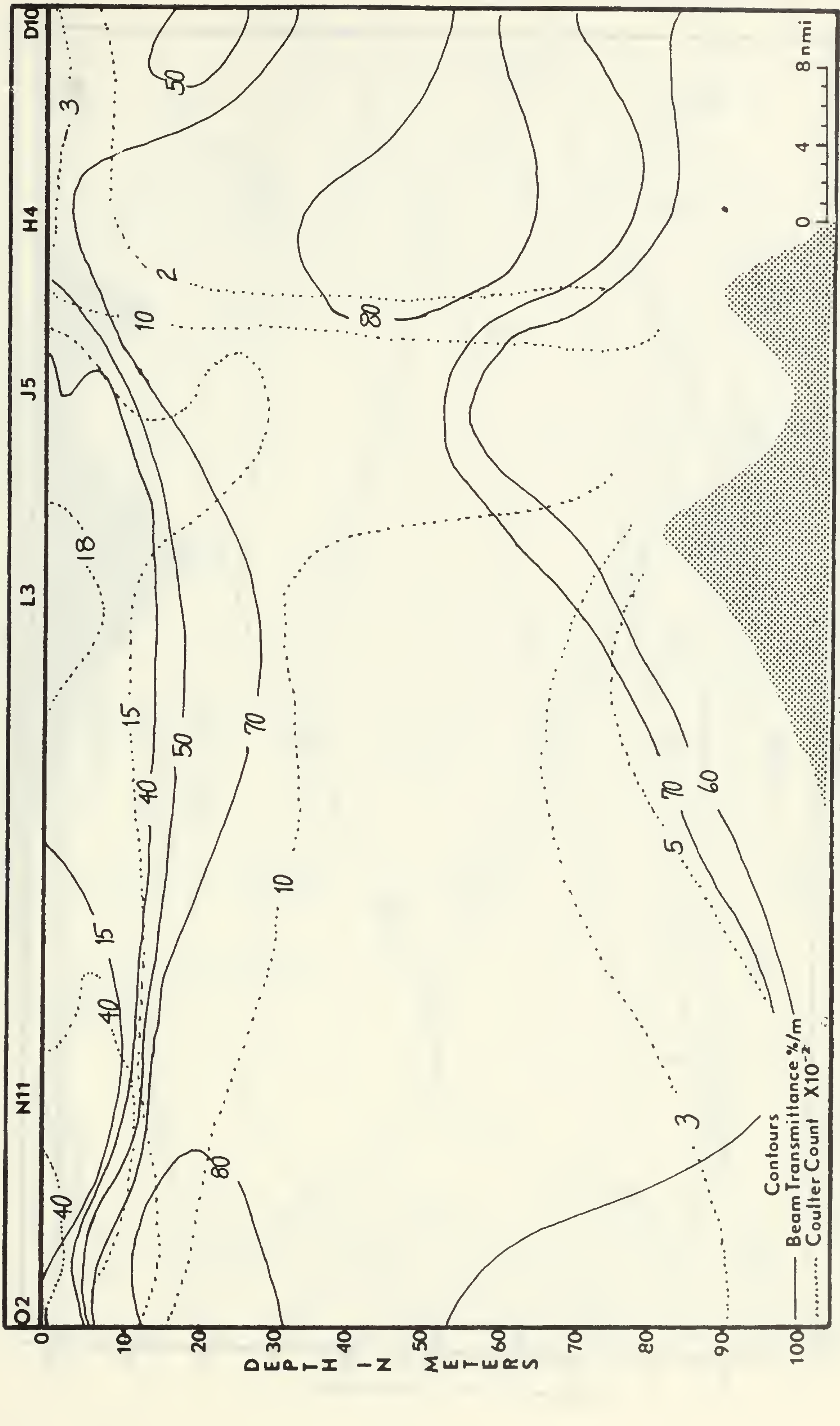


Vertical Cross Section 15

Beam Transmittance in Relation to Temperature

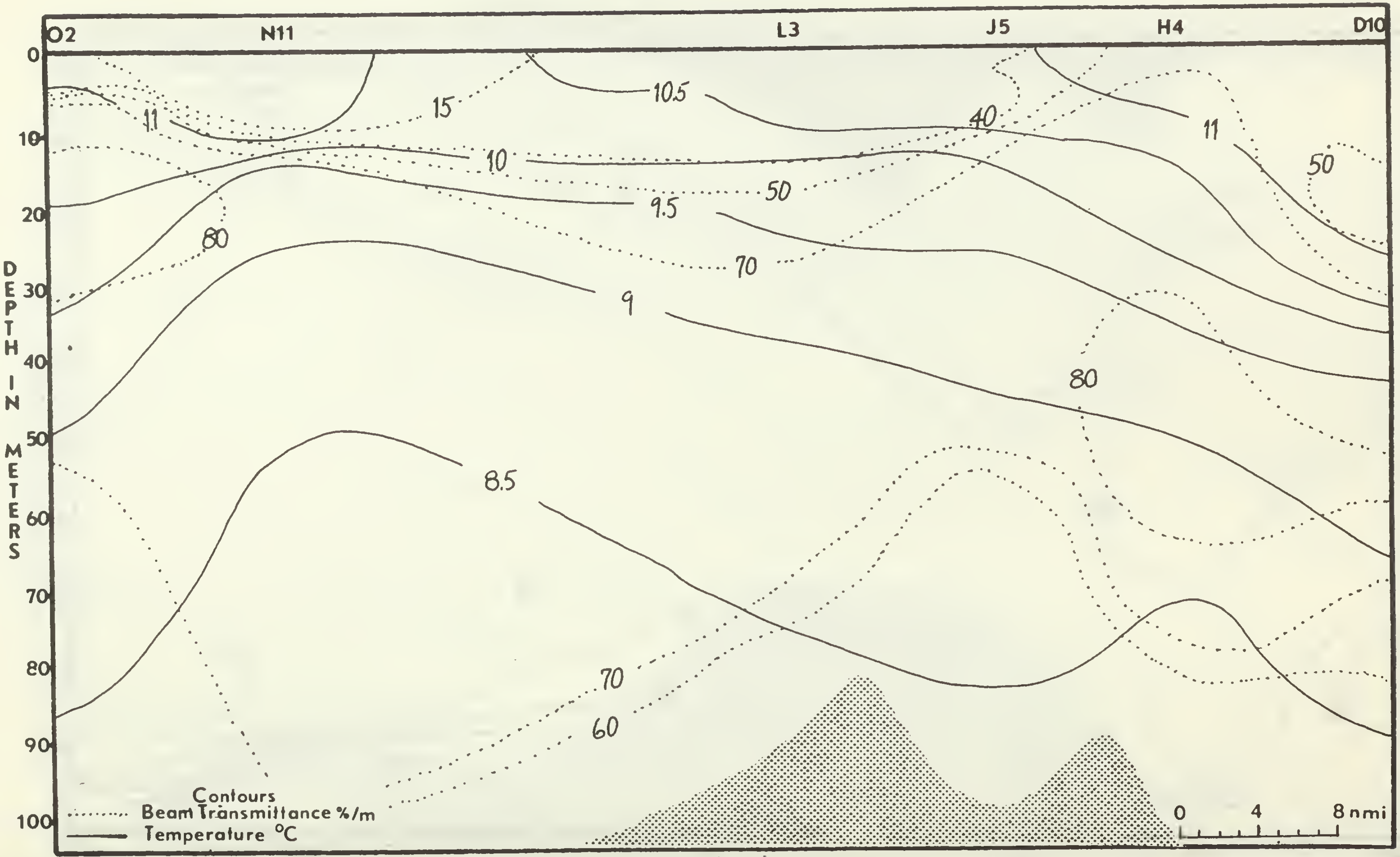


Vertical Cross Section 15
Temperature in Relation to Coulter Count



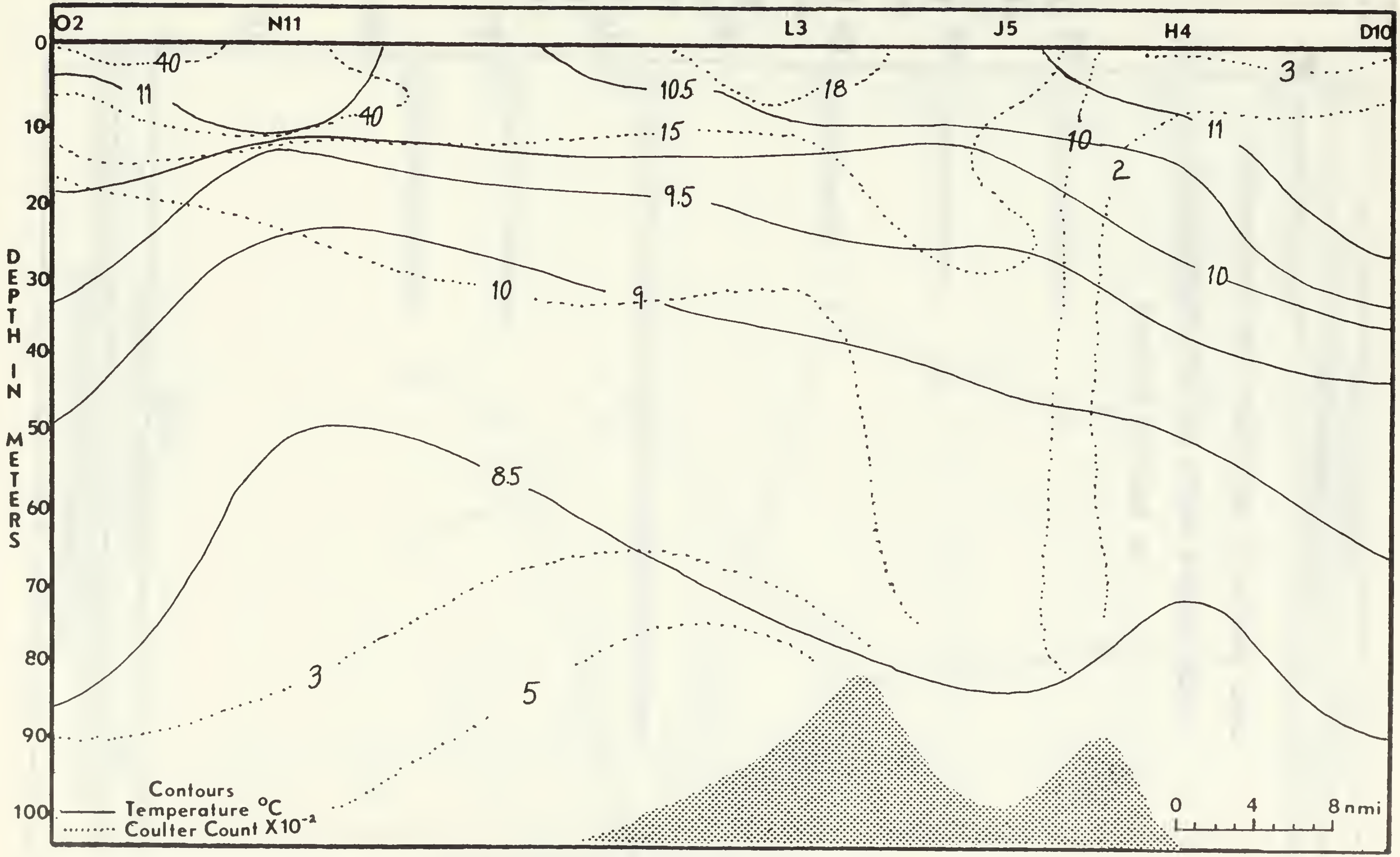
Vertical Cross Section 16

Beam Transmittance in Relation to Coulter Count



Vertical Cross Section 16

Beam Transmittance in Relation to Temperature

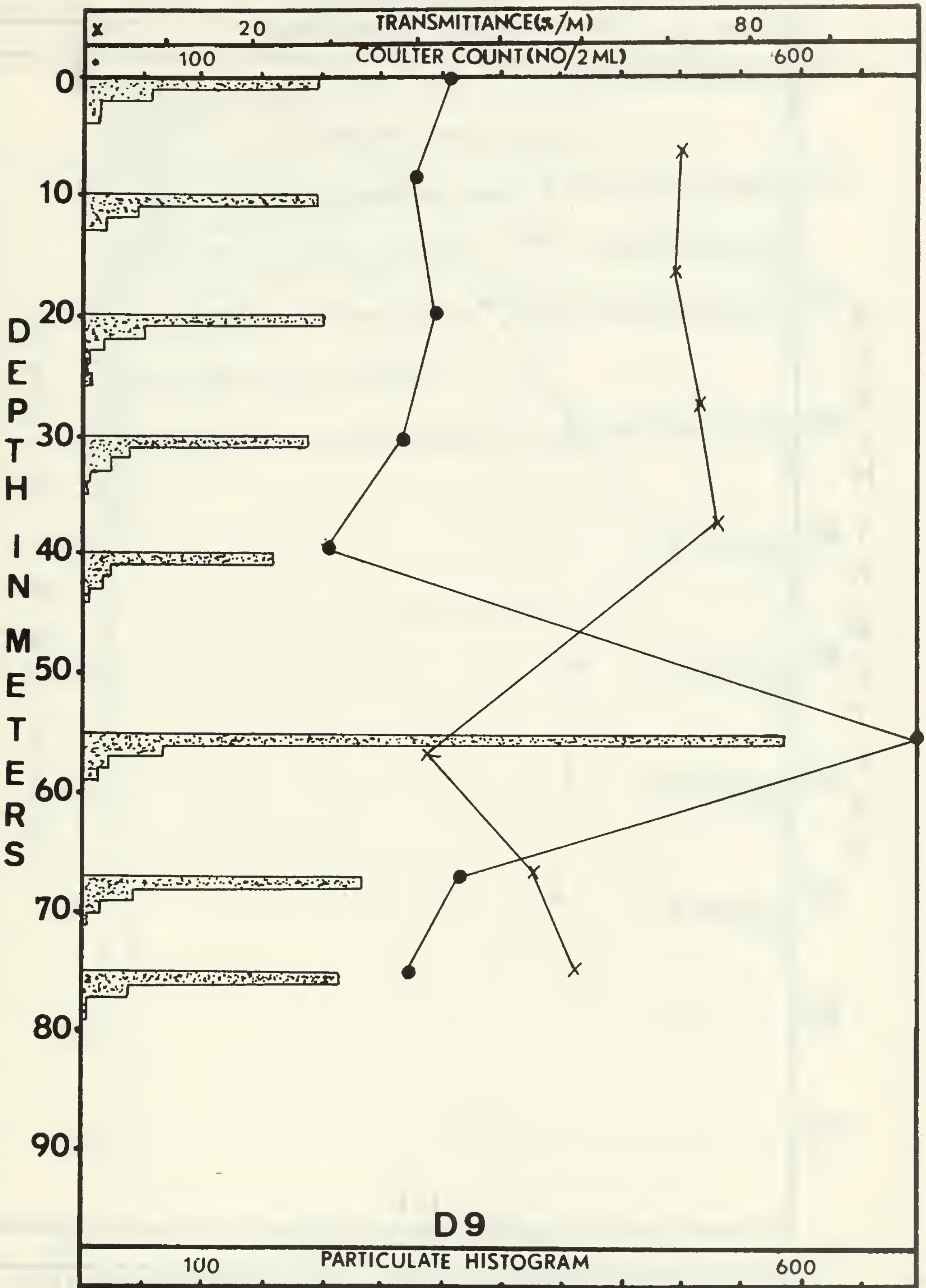


Vertical Cross Section 16

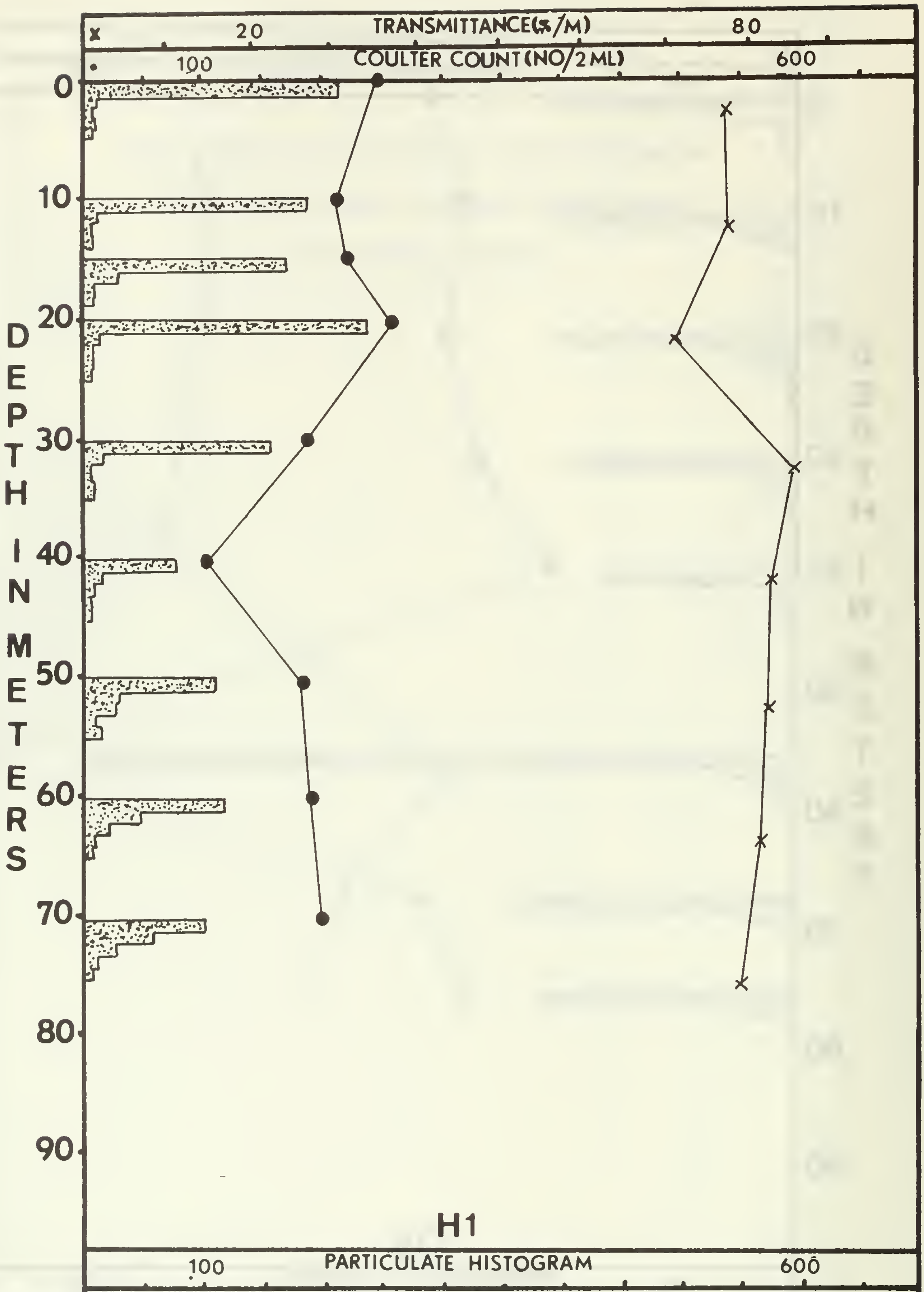
Temperature in Relation to Coulter Count

APPENDIX D

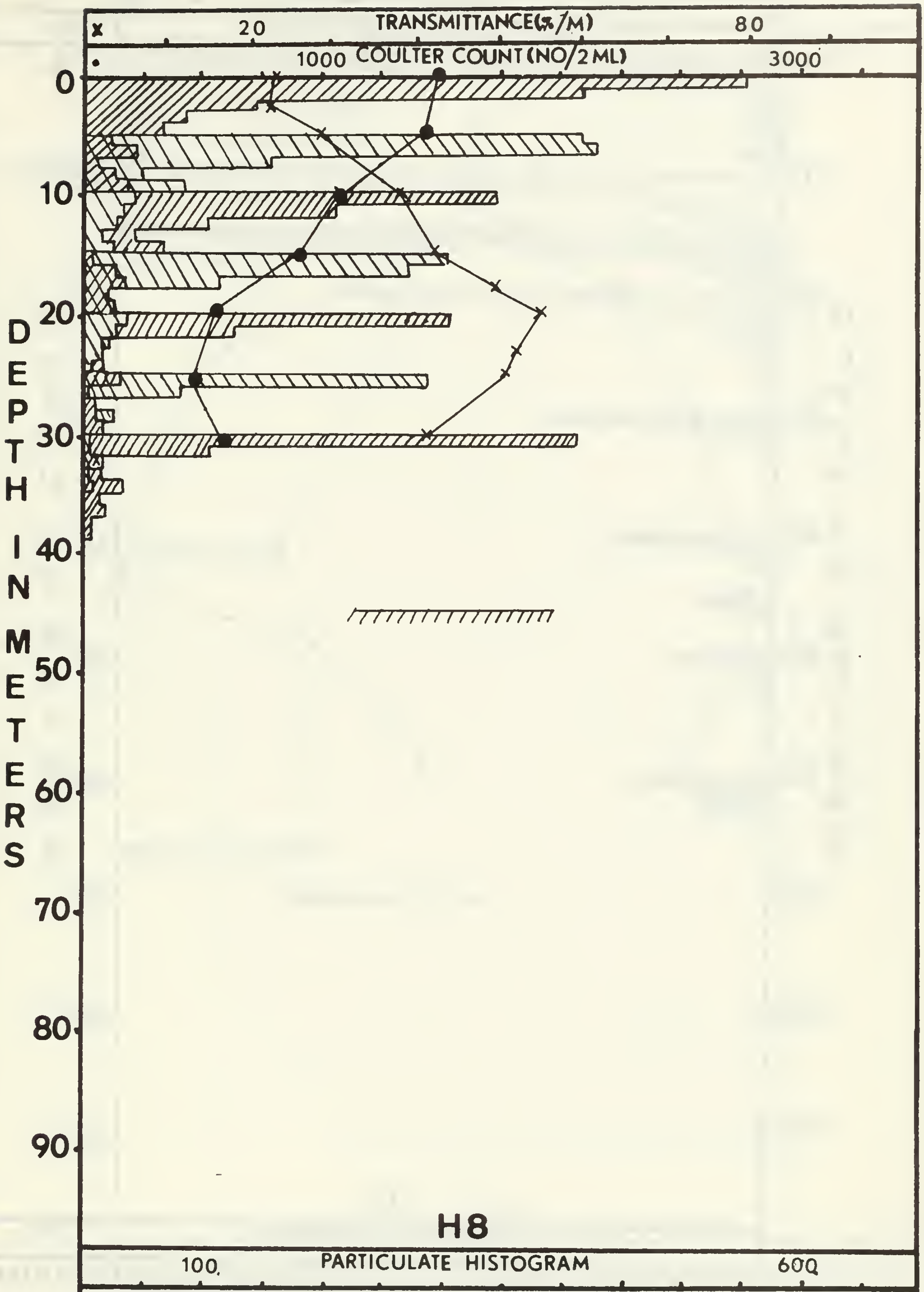
DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE AT SELECTED STATIONS



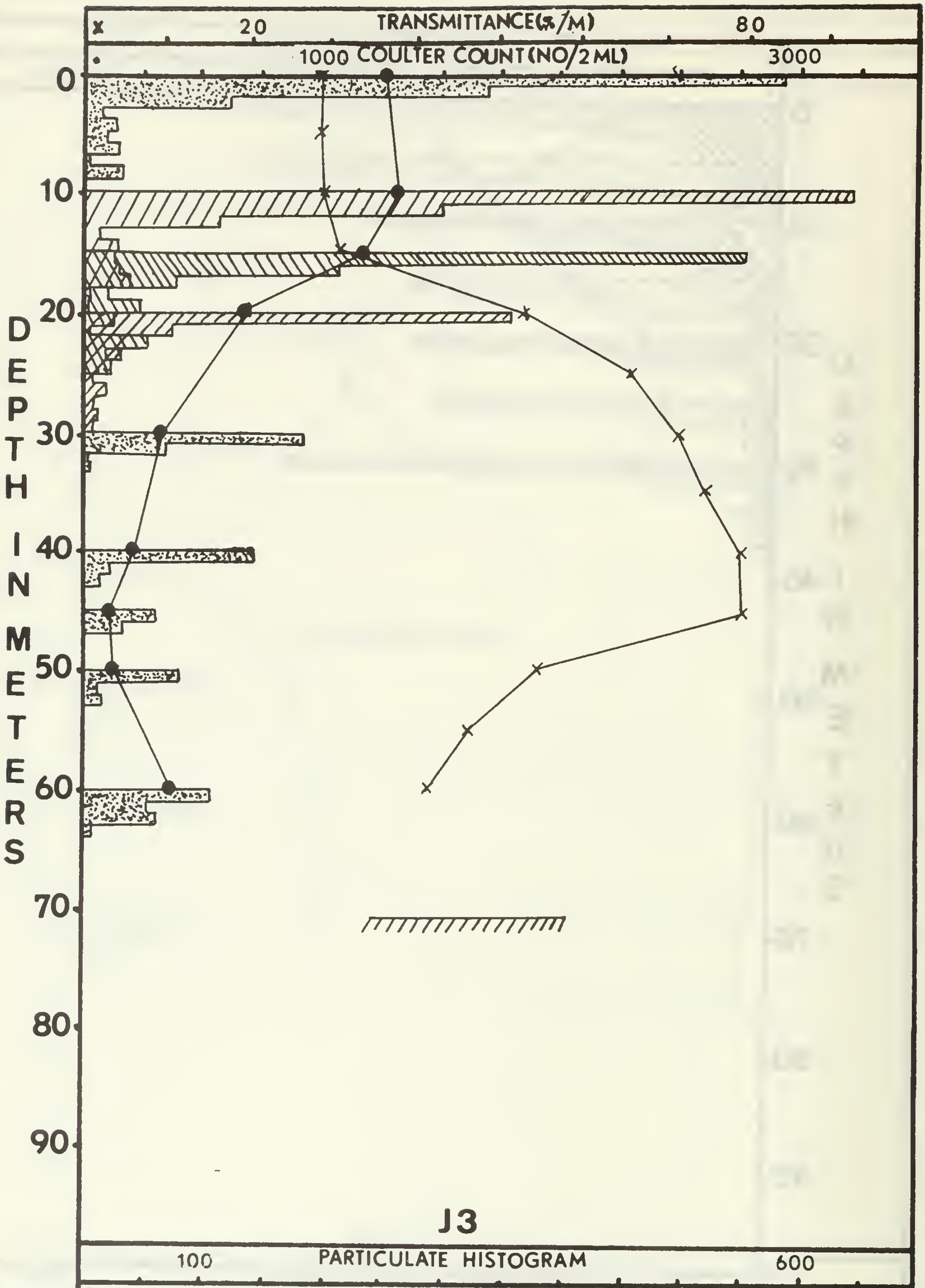
DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE



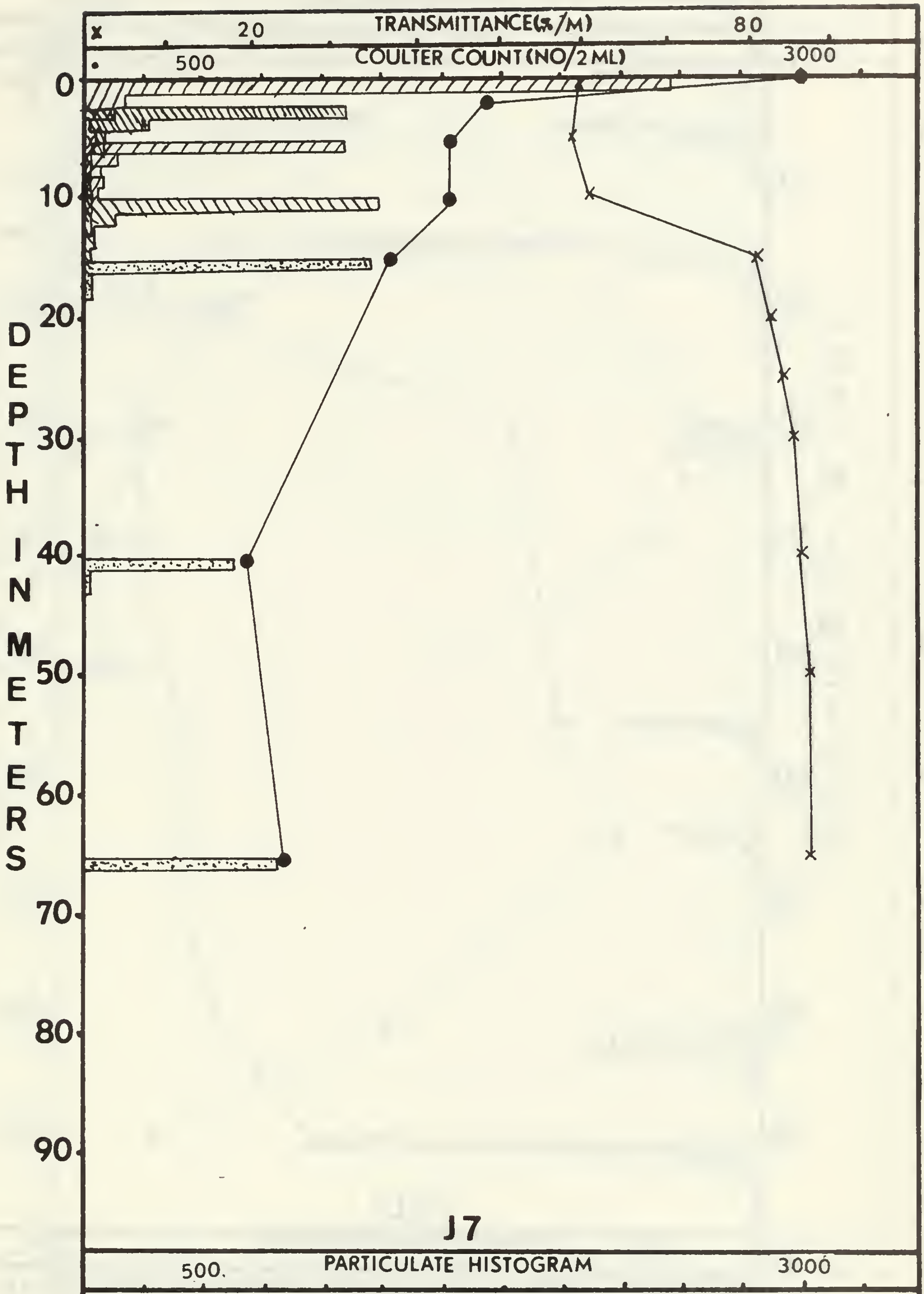
DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE



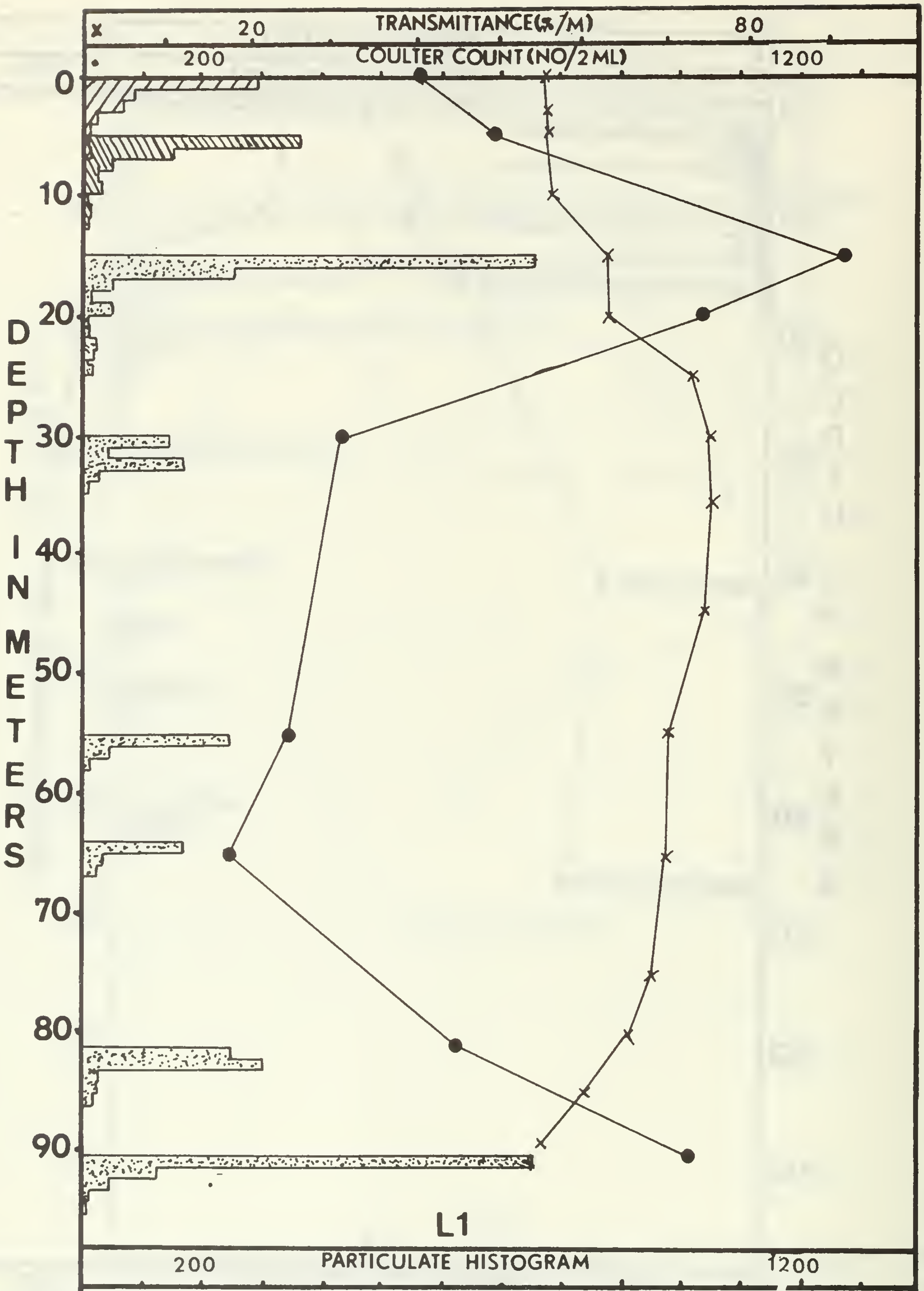
DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE



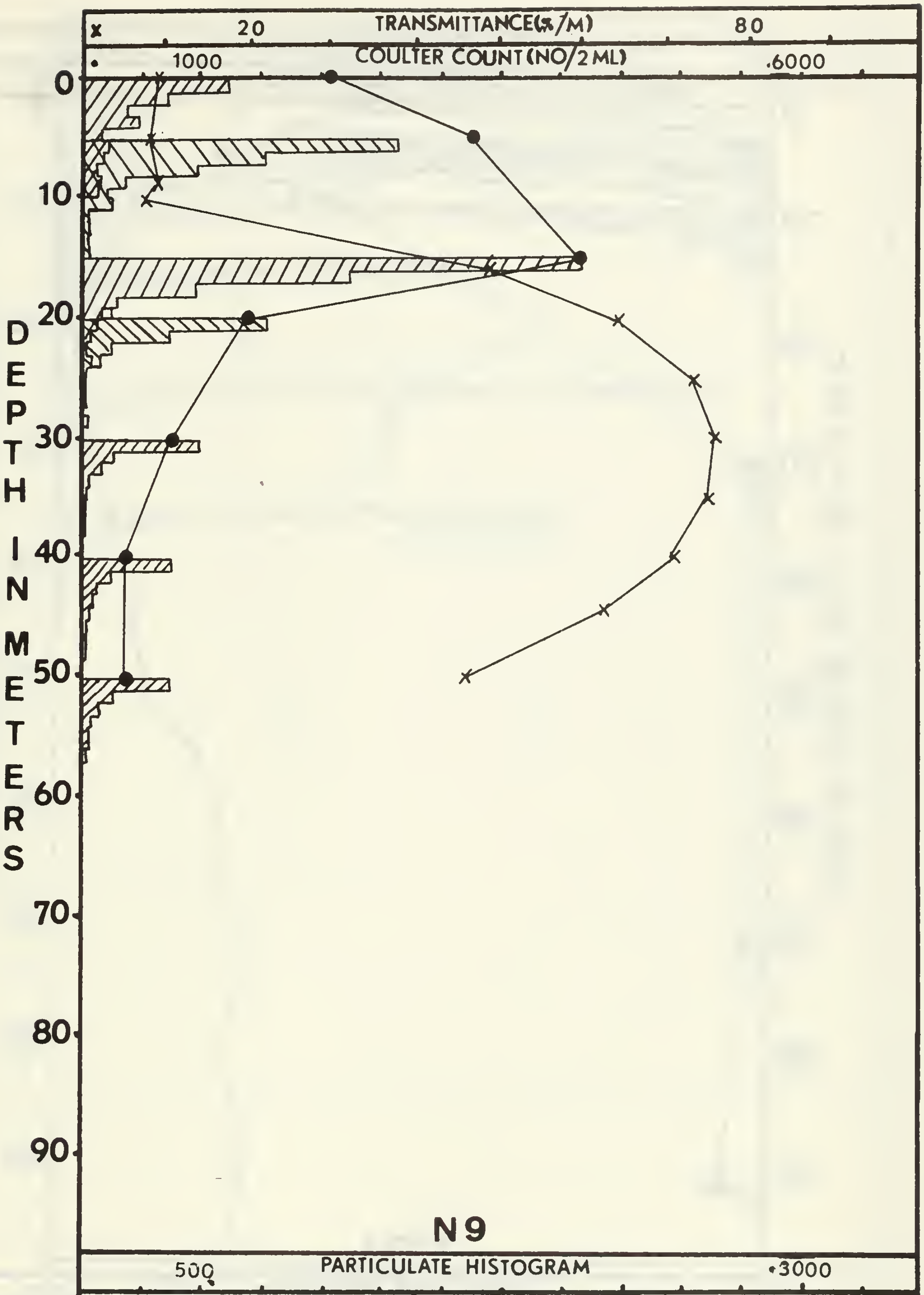
DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE



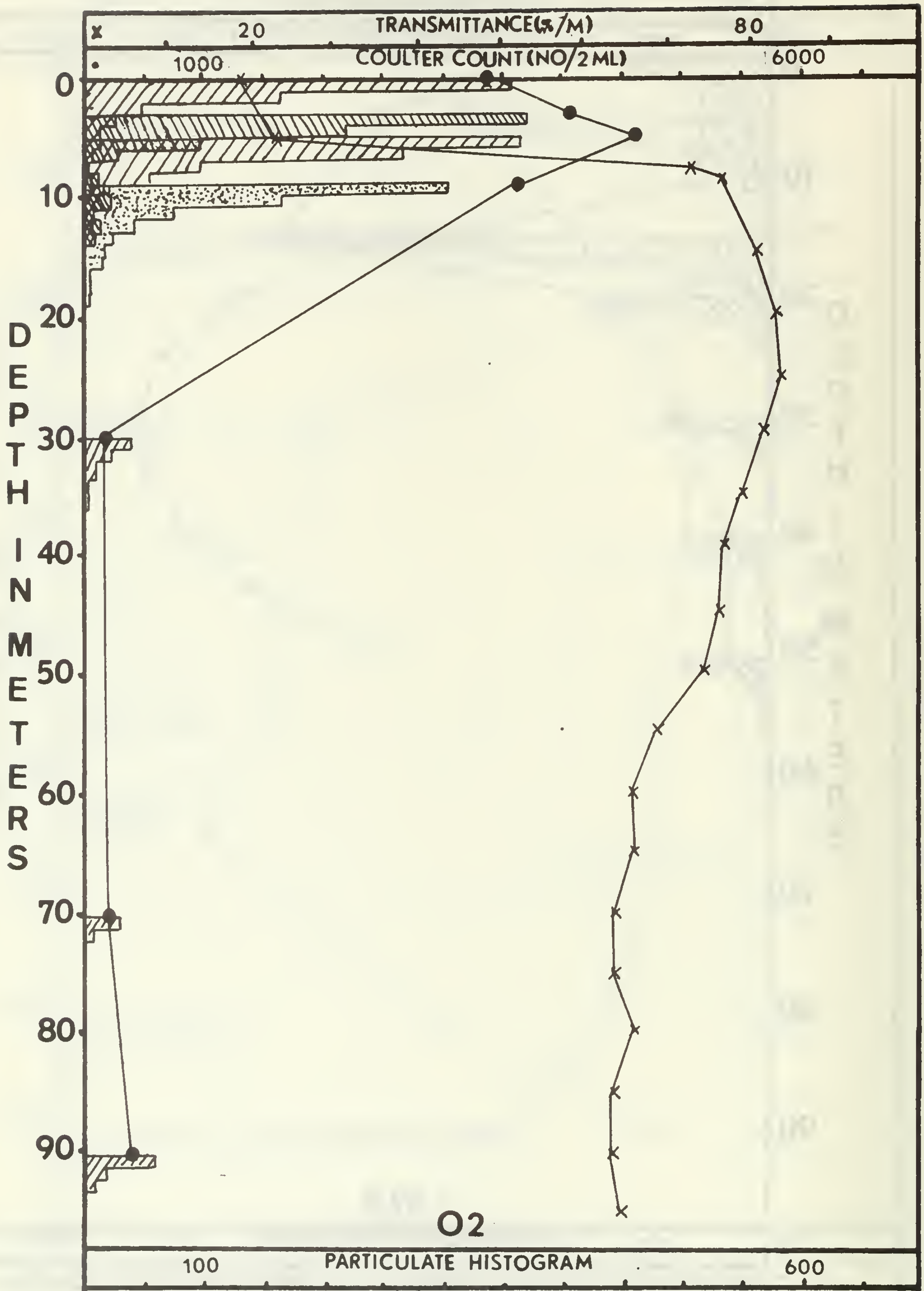
DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE



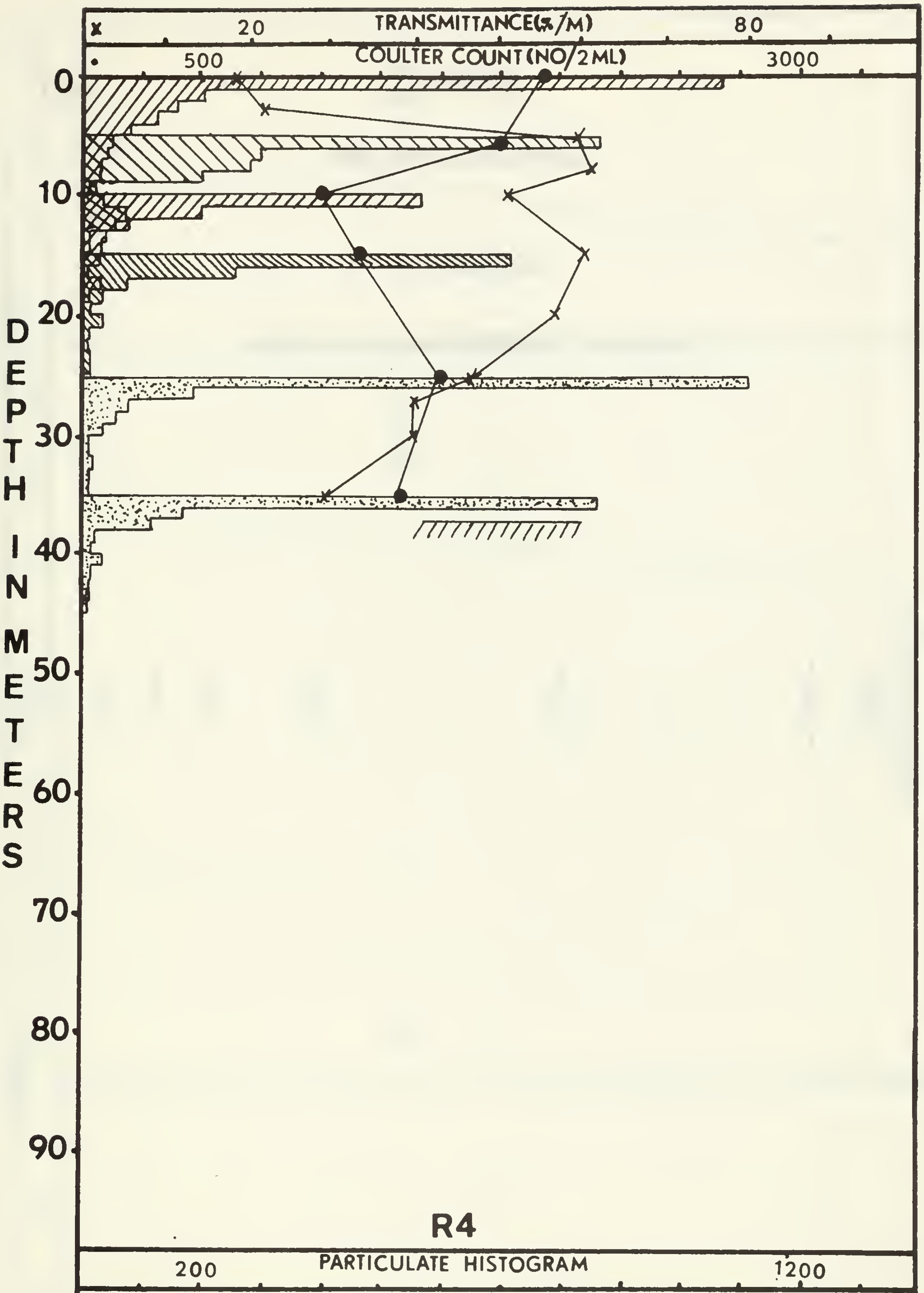
DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE



DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE



DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE



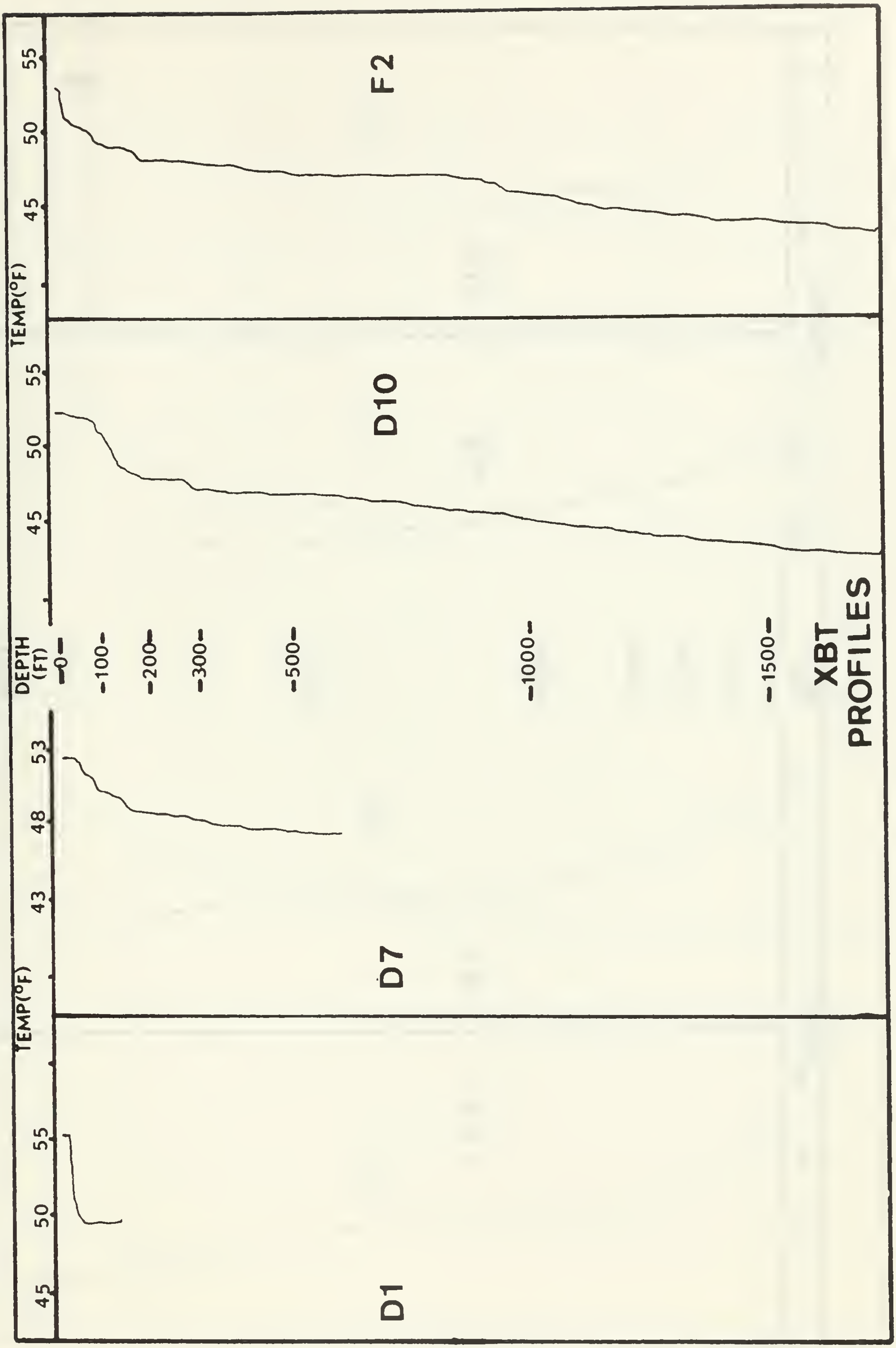
DEPTH PROFILE OF PARTICULATE SIZE DISTRIBUTION, TOTAL COULTER COUNT, AND BEAM TRANSMITTANCE

APPENDIX E

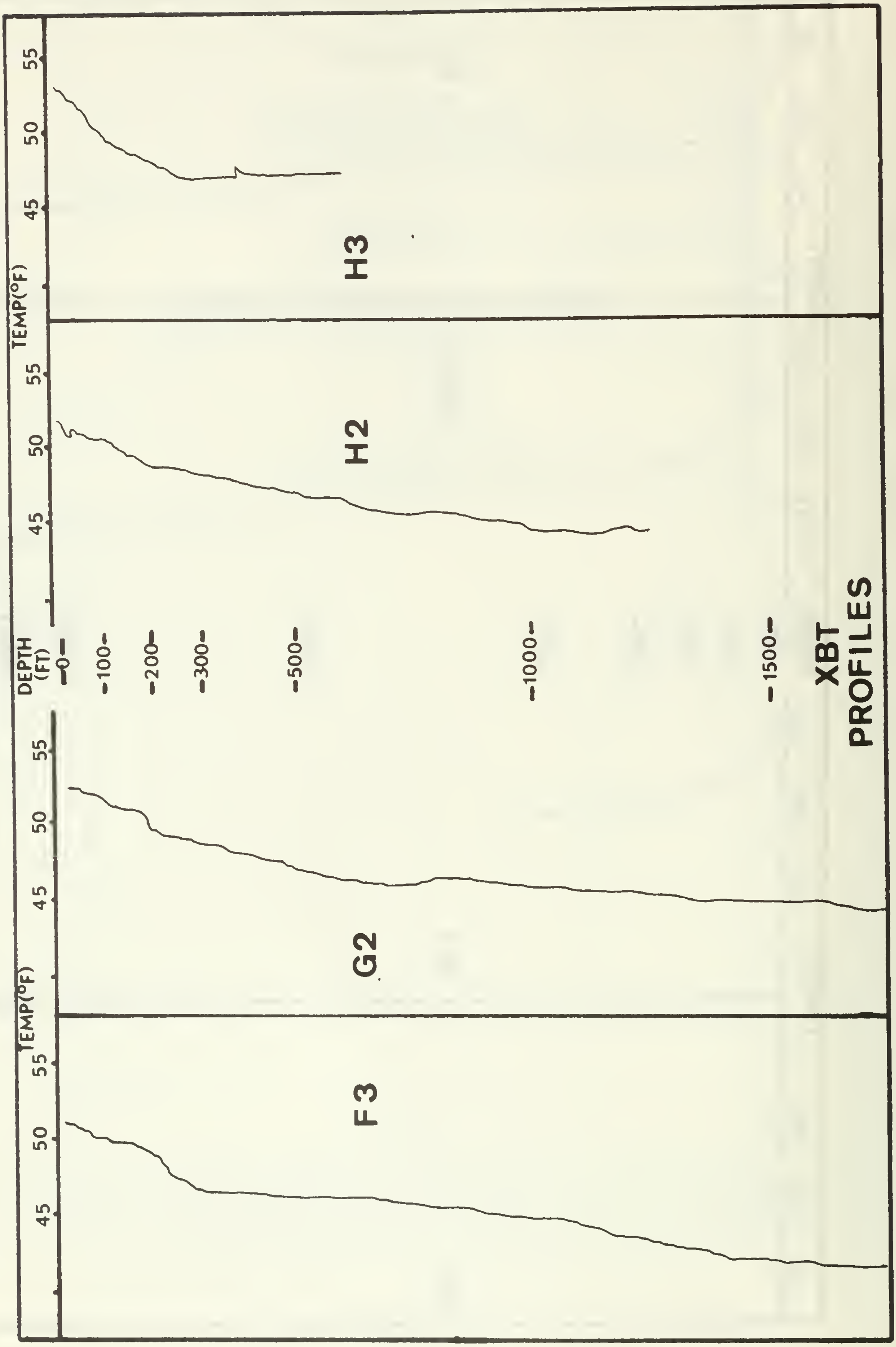
BATHYTHERMOGRAPH DATA

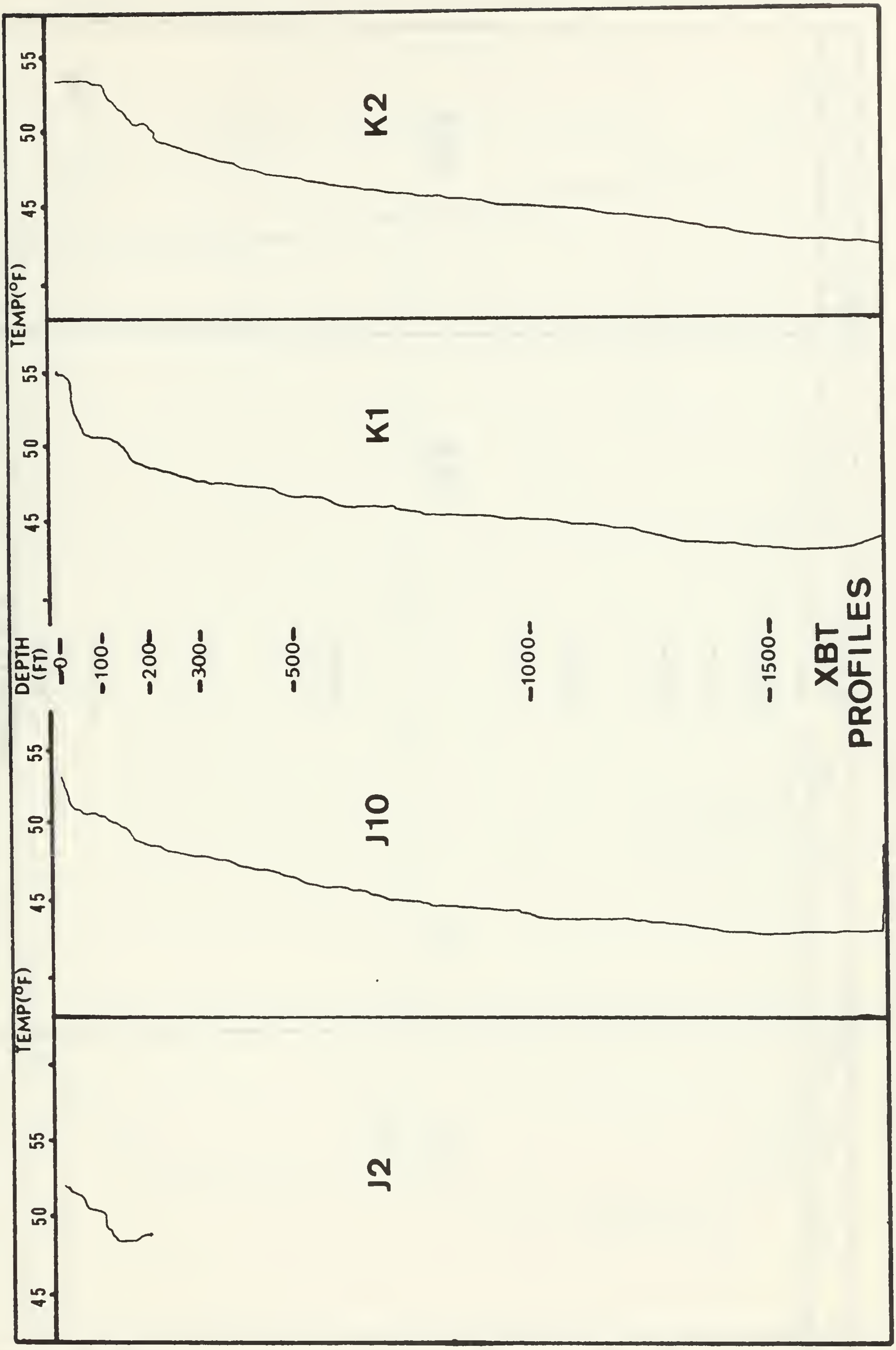
APPENDIX E1

EXPENDABLE BATHYTHERMOGRAPH TRACES

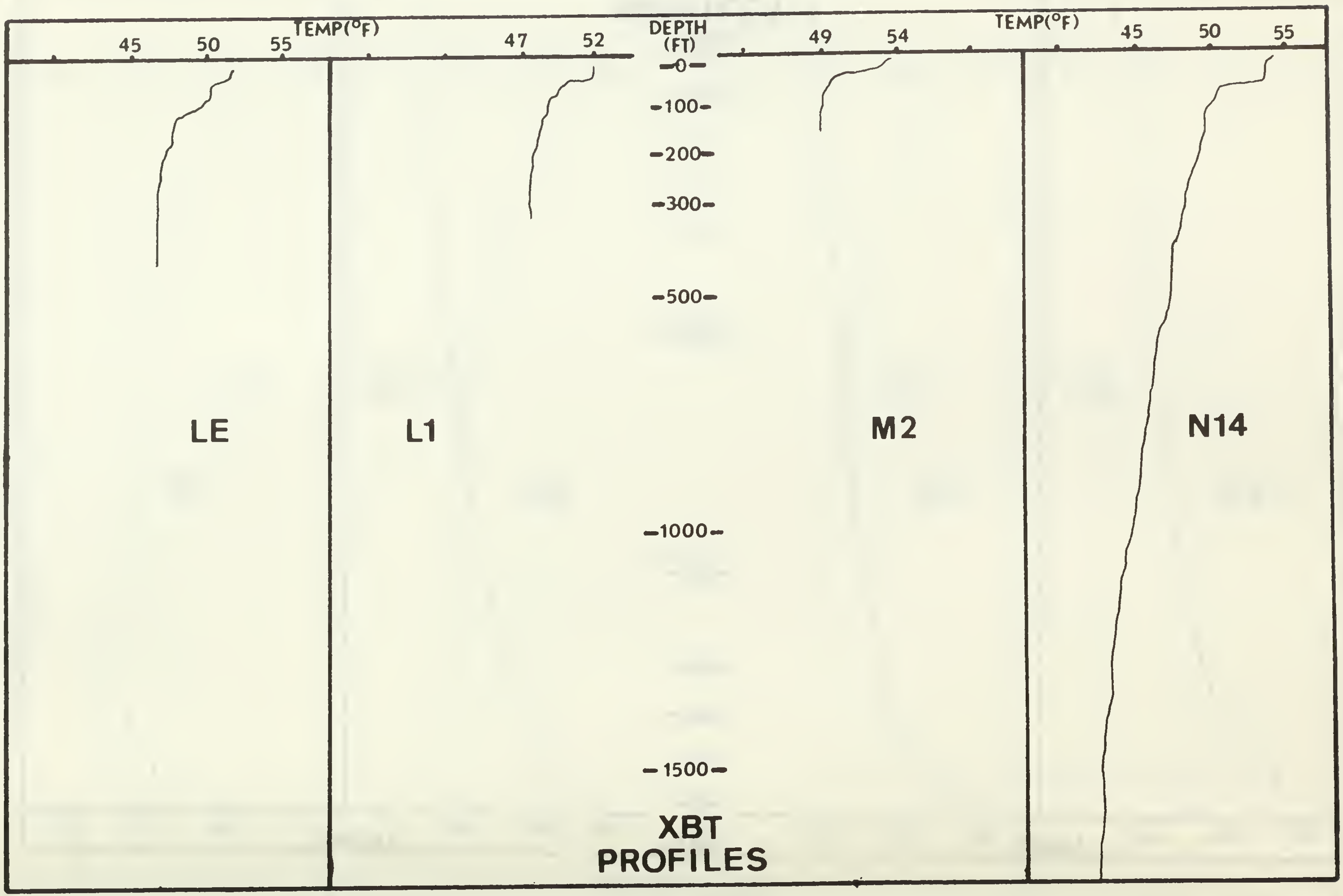


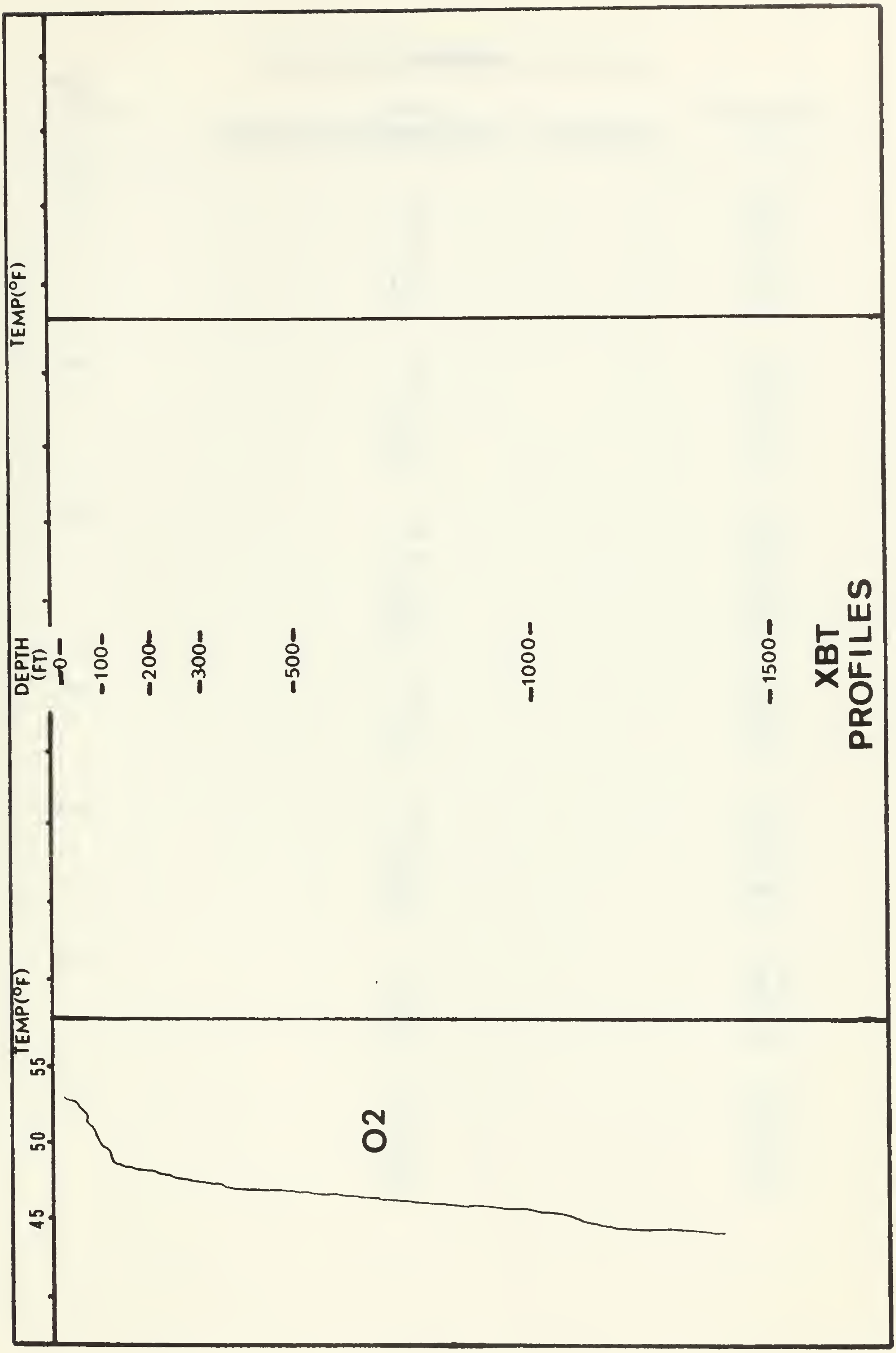
XBT PROFILES


XBT PROFILES
H3
H2
G2
F3
TEMP(°F)
45
50
55
DEPTH (FT)
0
100
200
300
500
1000
1500



XBT PROFILES


TEMP(°F)
45
50
55
47
52
DEPTH (FT)
0
100
200
300
500
1000
1500
49
54
TEMP(°F)
45
50
55
LE
L1
M2
N14
XBT PROFILES


XBT
PROFILES
DEPTH
(FT)
0
100
200
300
500
1000
1500
TEMP(°F)
TEMP(°F)
55
50
45
O2

APPENDIX E2

MECHANICAL BATHYTHERMOGRAPH FEATURES

MECHANICAL BATHYTHERMOGRAPH DATA

STATION	DEPTH (FT)	TEMPERATURE (°F)
J-6	0	51.0
	30	51.0
	50	50.6
	70	50.3
	120	48.0
	230	46.8
H-6	0	53.0
	40	52.0
	80	51.0
	100	49.0
	220	47.5
D-14	0	52.1
	20	52.1
	40	50.9
	120	48.7
	180	48.4
	320	46.9
R-4	0	53.0
	20	52.5
	30	49.5
	90	47.0
N-7	0	53.5
	80	48.0
	140	47.0
	160	46.5
	220	45.3
N-2	0	52.5
	50	48.0
	70	48.0
	140	47.0
L-6	0	51.0
	80	51.0
	110	49.2
	140	47.5
	260	47.0

APPENDIX F

CRUISE SUMMARY

APPENDIX F1

CRUISE NARRATIVE

The first cast was made at D-1 with the S/T/D and c-meter in tandem. The SV/T/D was inoperative at this time and remained so until D-6(1). On this cast problems developed with the c-meter cable and air balance could not be achieved,and repairs were begun. At D-6(1) the bottom water sampler "hung up" on the Monterey Canyon wall,and the hydrographic wire parted. Subsequent stations now consisted of only two casts. At D-6(2); the first cast consisted of the SV/T/D and c-meter until D-8,when the SV/T/D, S/T/D and c-meter were utilized on the same cast. This operation proved very cumbersome and provided a potential source of equipment damage while initiating and retrieving the cast and was abandoned. Subsequent first casts utilized the SV/T/D and the c-meter in tandem. At K-1, upon initiation of the water sample cast, problems developed with the 3/16" wire. Since time was a major factor, water samples were not taken at K-1, K-2, and LE, and repairs made while proceeding to L-1. From L-1 until N-7, the SV/T/D and the S/T/D were alternated as the instrument on the first cast with the c-meter due to battery charging requirements. A strip chart recorder for beam transmittance readings was installed at L-4 and was used for the remainder of the cruise. Upon retrieving the S/T/D at N-7, it was found to be flooded. The instrument was disassembled, cleaned, and dried according to the instruction manual. N-13 provided the last instrument casualty when the cable of the c-meter parted at the connectors, necessitating a cable splice. It was returned to service at 0-1,and no problems occurred for the remainder of the cruise.

APPENDIX F2

EQUIPMENT UTILIZED

STATION	C-METER	SV/T/D	BOTTOM SAMP	CHLOR	PART	SAL	XBT	MBT	S/T/D
D-1	X	0	X	0	X		X		0
D-2		0	X						0
D-3		0							0
D-4		0	X						0
D-5		0							0
D-6(1)		X	LOST						0
D-6(2)	X	X		0	X				
D-7	X	X		0	X		0		
D-8	X	X		0	X				0
D-9	X			0	X				0
D-10	X			0	X	X	X		0
D-11	X			0	X				0
D-13	X				X	X			0
D-14	X			0	X			X	0
F-1	X				X	X			0
F-2	X			0	X		X		0
F-3	X	X		0	X		0		
G-1	X	X		0	X				
G-2	X	X			X		0		
H-1	X	X		0	X				

X - DATA UTILIZED IN ANALYSIS

0 - DATA NOT UTILIZED IN ANALYSIS

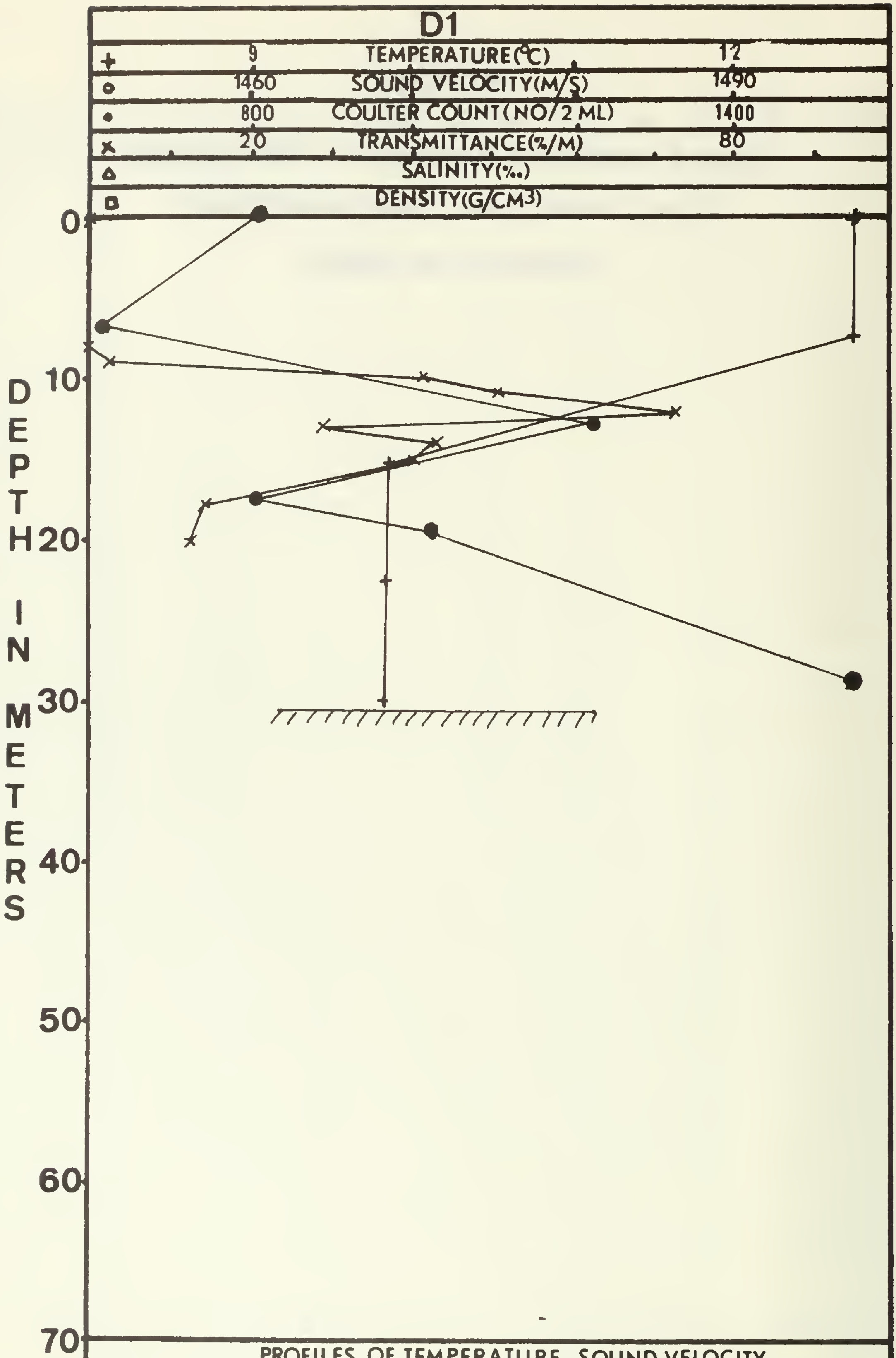
STATION	C-METER	SV/T/D	BOTTOM SAMP	CHLOR	PART	SAL	XBT	MBT	S/T/D
H-2	X	X		0	X		0		
H-3	X	X		0	X		0		
H-4	X	X		0	X				
H-5	X	X		0	X				
H-6	X	X		0	X			0	
H-7	X	X		0	X				
H-8	X	X		0	X				
I-1	X	X		0	X				
I-2	X	X		0	X				
J-1	X	X		0	X				
J-2	X	X		0	X		0		
J-3	X	X		0	X				
J-4	X	X		0	X				
J-5	X	X		0	X				
J-6	X	X		0	X			0	
J-7	X	X		0	X				
J-8	X	X		0	X				
J-9	X	X		0	X				
J-10	X	X		0	X		0		
K-1							0		0
K-1-B		X				X	0		0
K-2	X						0		
LE							X		
L-1	X			0	X		X		0

STATION	C-METER	SV/T/D	BOTTOM SAMP	CHLOR	PART	SAL	XBT	MBT	S/T/D
L-2	X			0	X				0
L-3	X			0	X				0
L-4	X			0	X				0
L-5	X	X		0	X				
L-6	X	X		0	X			0	0
L-7	X	X		0	X				0
L-8	X	X		0	X				0
L-9	X	X		0	X				0
M-1	X	X		0	X				0
M-2	X	X		0	X		0		0
M-3	X	X		0	X				0
N-1	X	X		0	X				
N-2	X	X		0	X		0		0
N-3	X	X		0	X				0
N-4	X	X		0	X				0
N-5	X	X		0	X				0
N-6	X	X		0	X				0
N-7	X	X		0	X	X	0		
N-8	X	X		0	X				
N-9	X	X		0	X				
N-10	X	X		0	X				
N-11	X	X		0	X				
N-12	X	X		0	X				
N-13		X		0	X				

STATION	C-METER	SV/T/D	BOTTOM SAMP	CHLOR	PART	SAL	XBT	MBT	S/T/D
N-14		X		0	X		0		
O-1	X	X		0	X				
O-2	X	X		0	X			0	
O-3	X	X		0	X				
P-1	X	X		0	X				
P-2	X	X		0	X				
R-1	X	X		0	X				
R-2	X	X		0	X				
R-3	X	X		0	X				
R-4	X	X		0	X			0	
S-1	X	X		0	X				
S-2	X	X		0	X				

APPENDIX G

STATION PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



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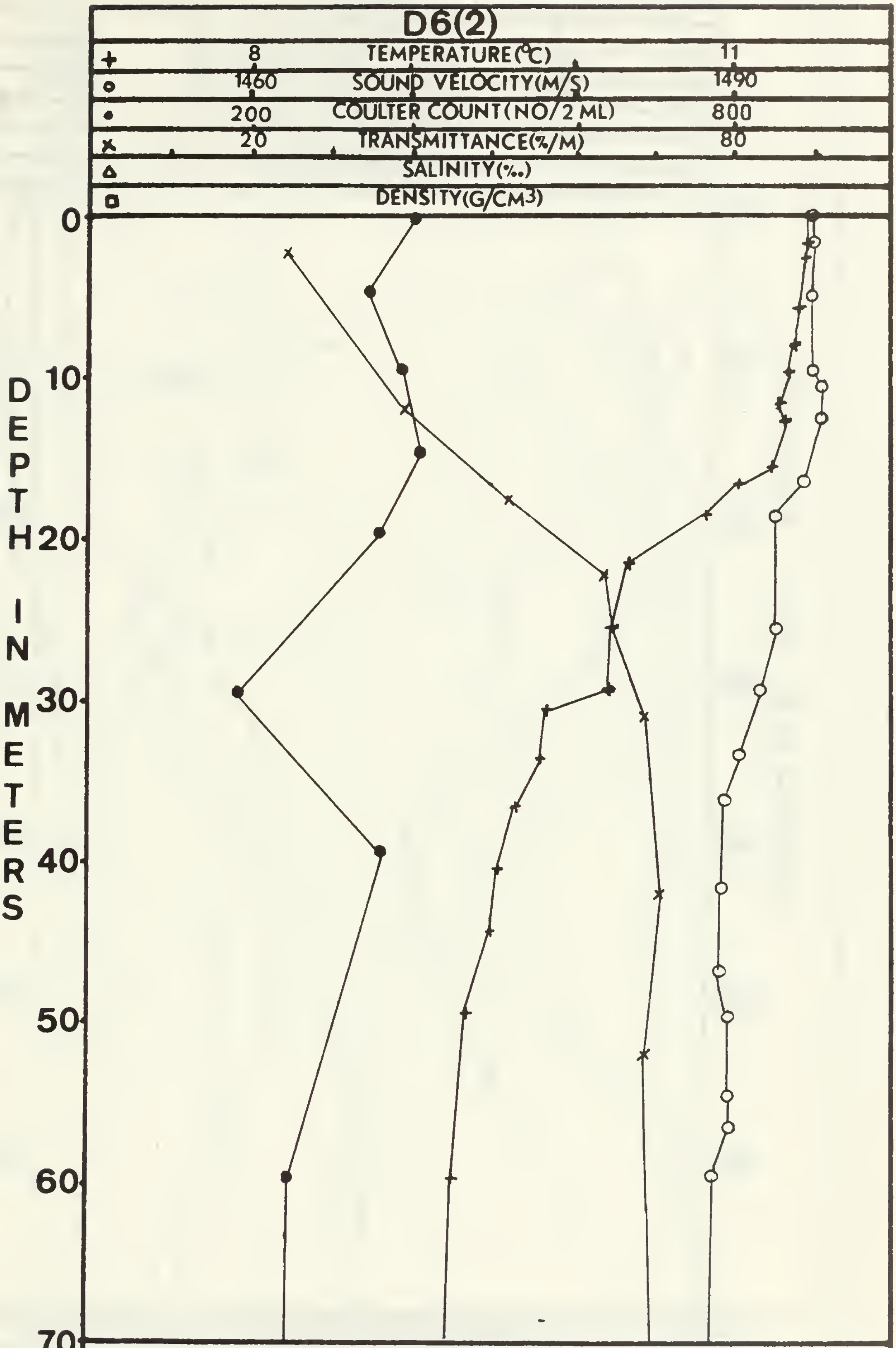

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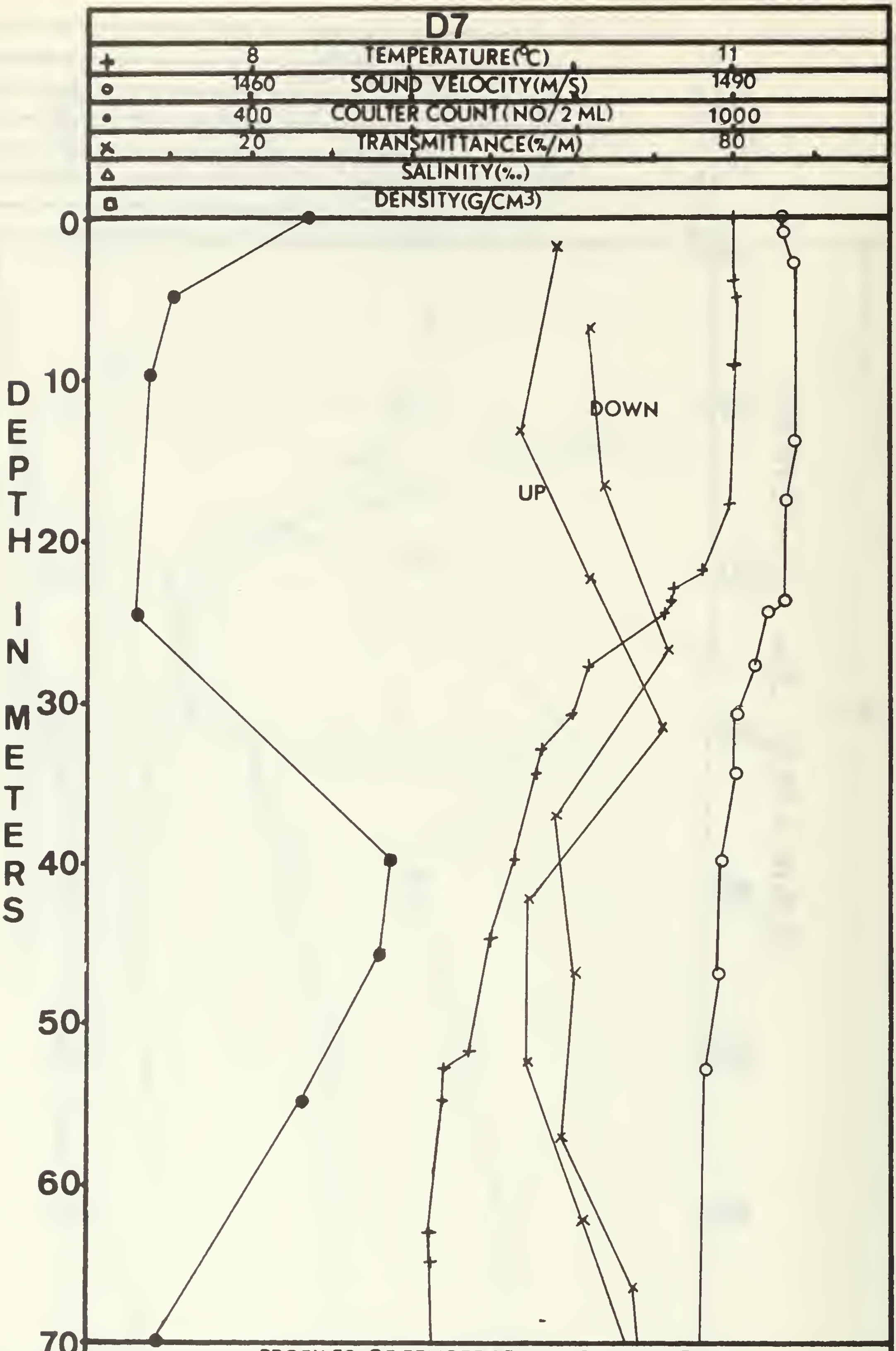

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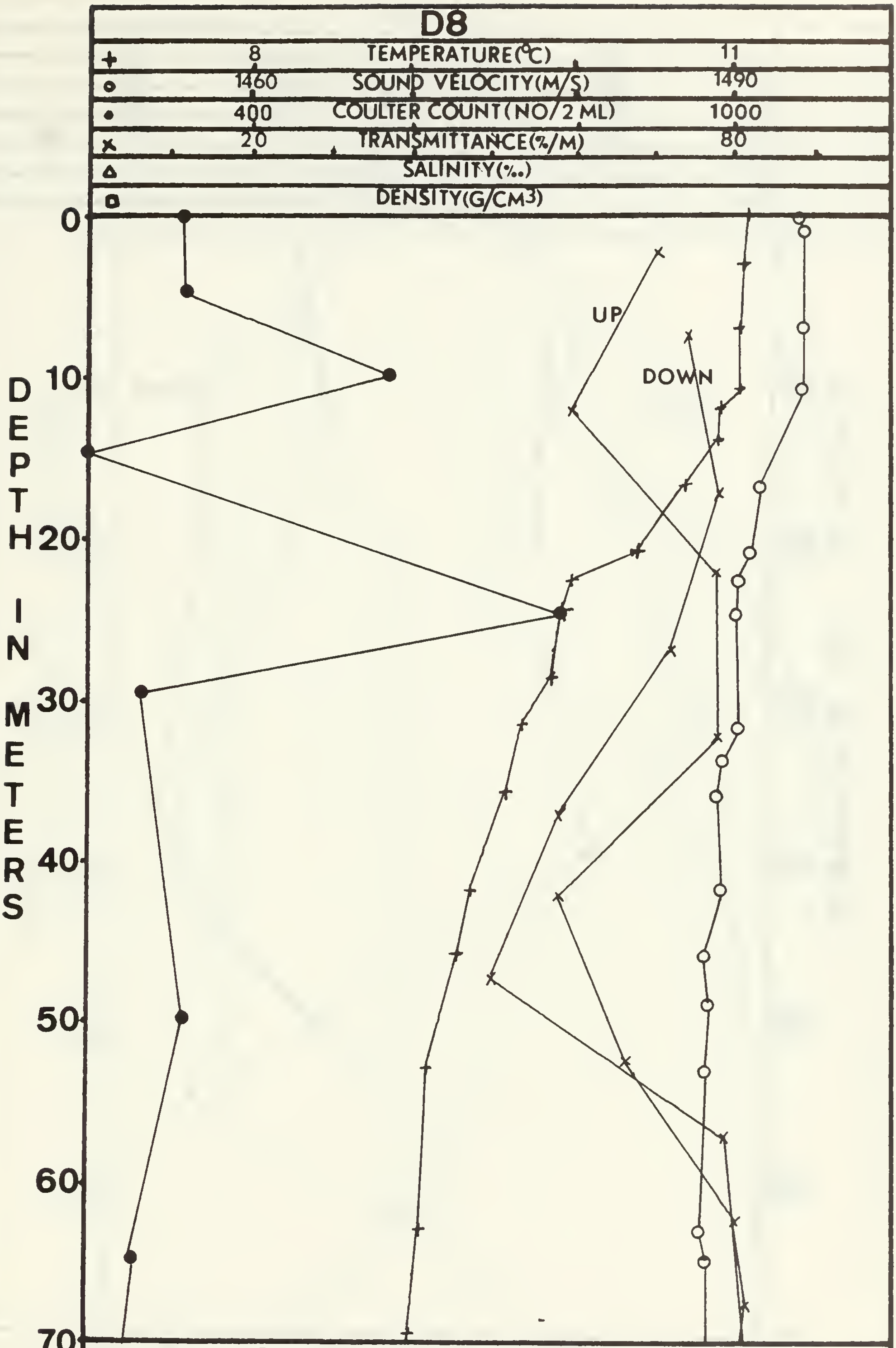

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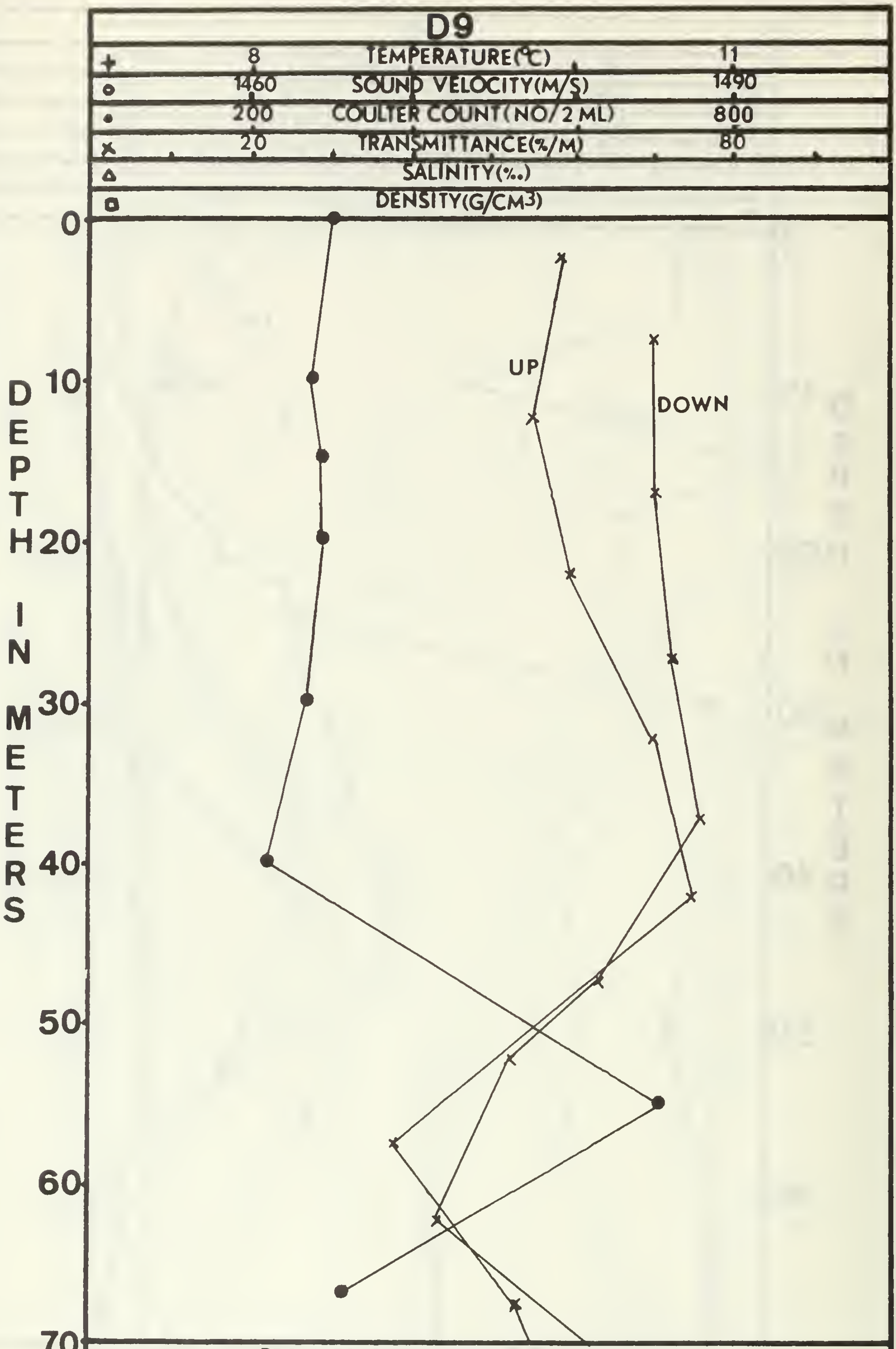

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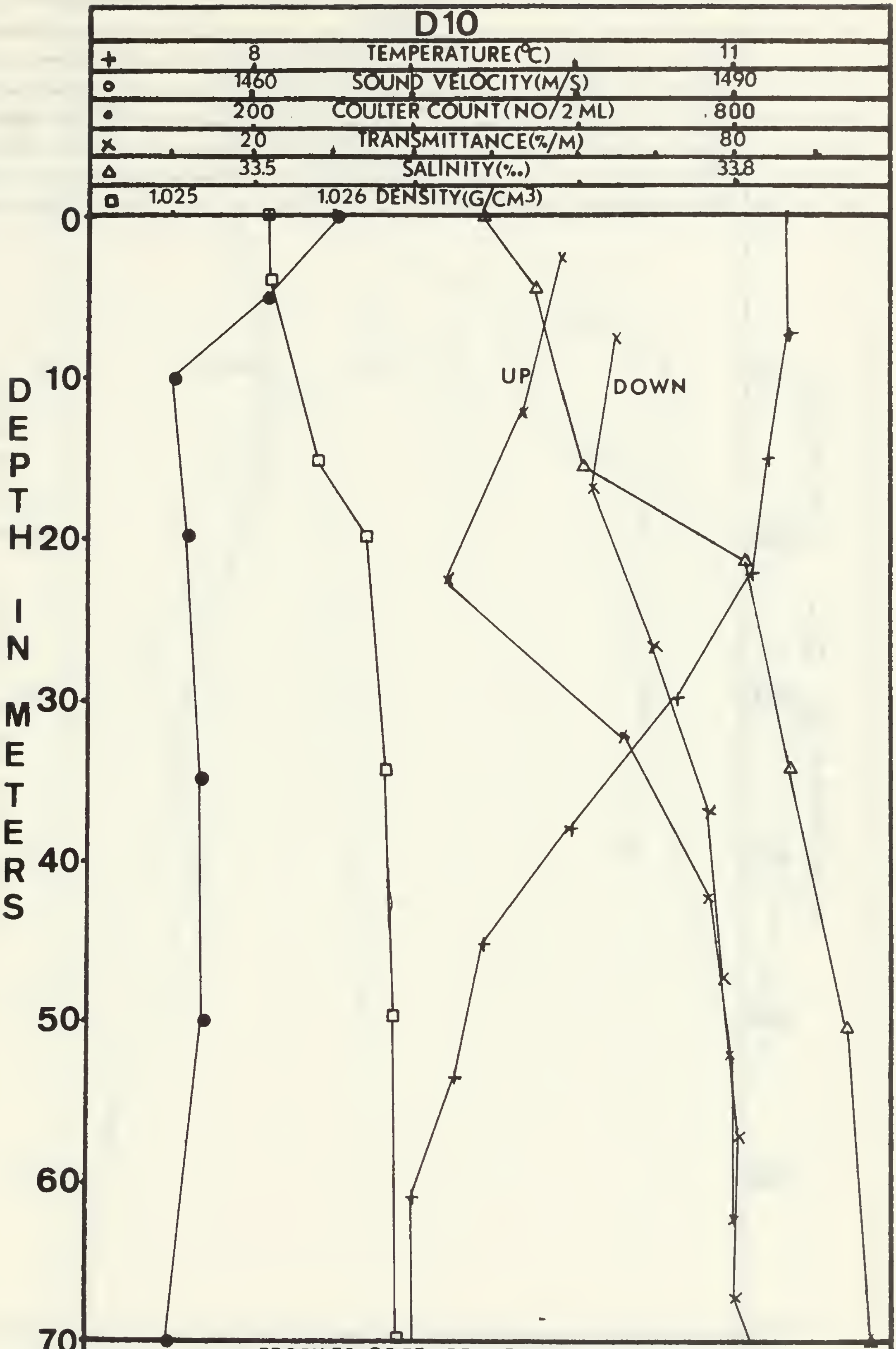

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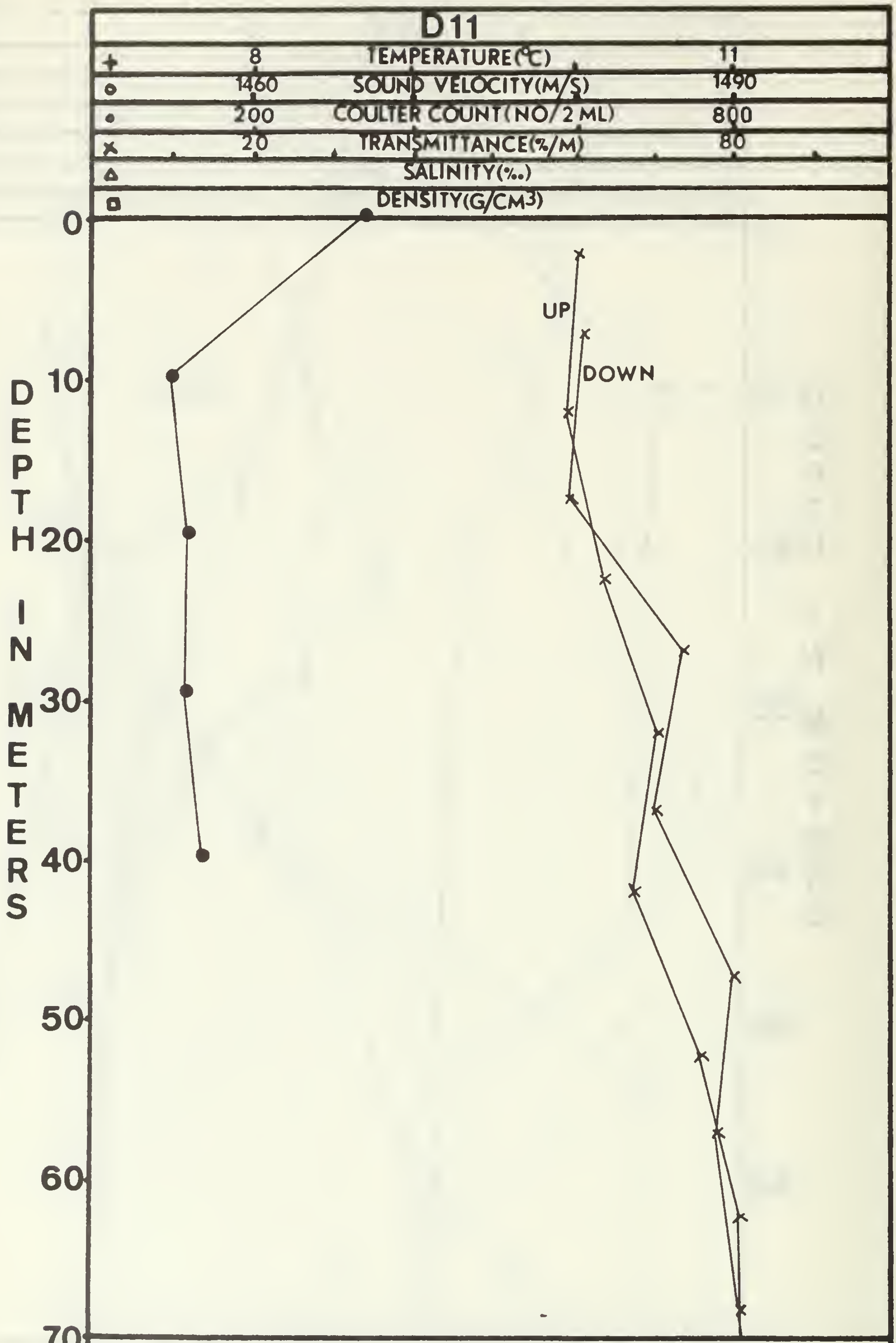

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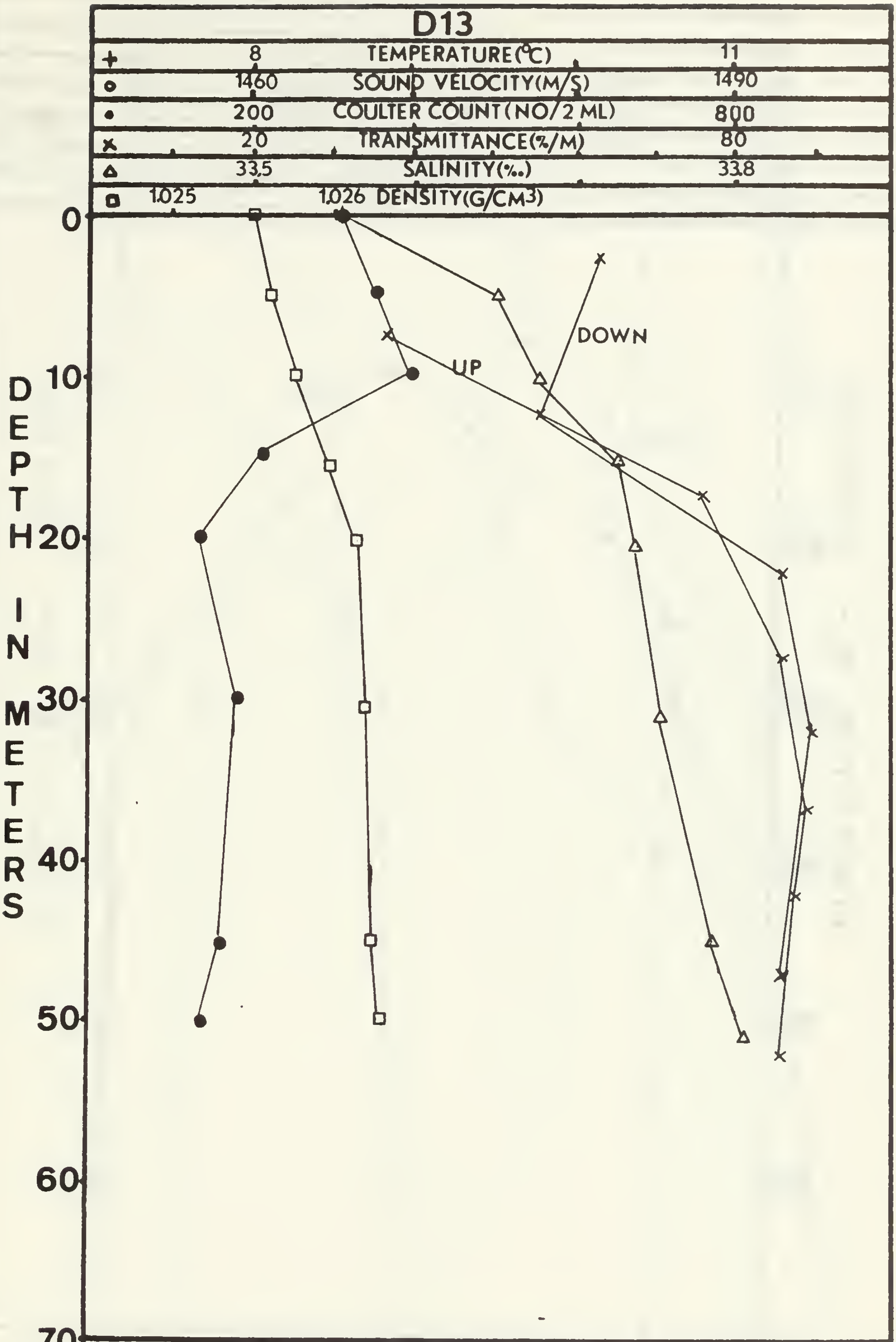

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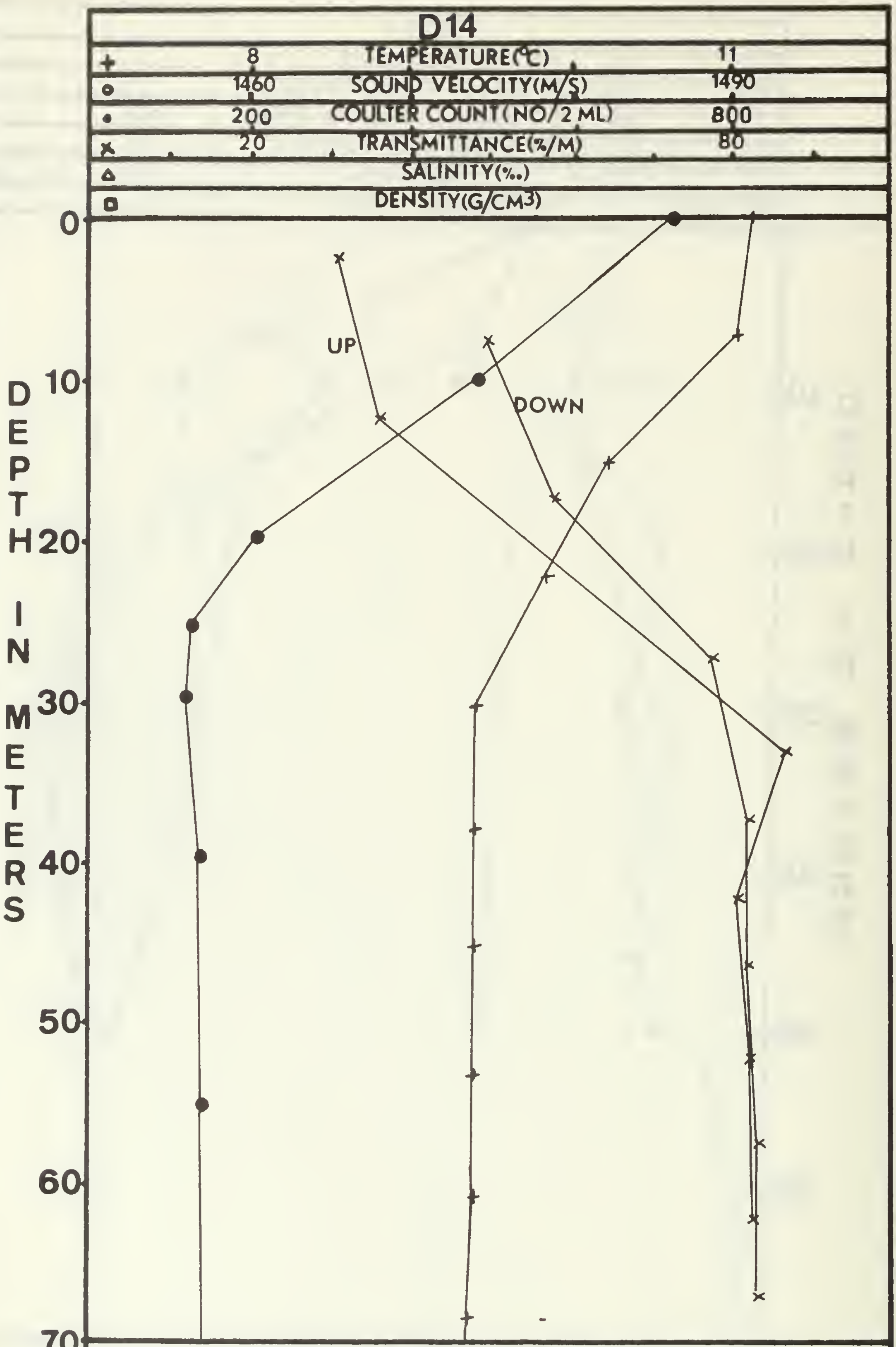

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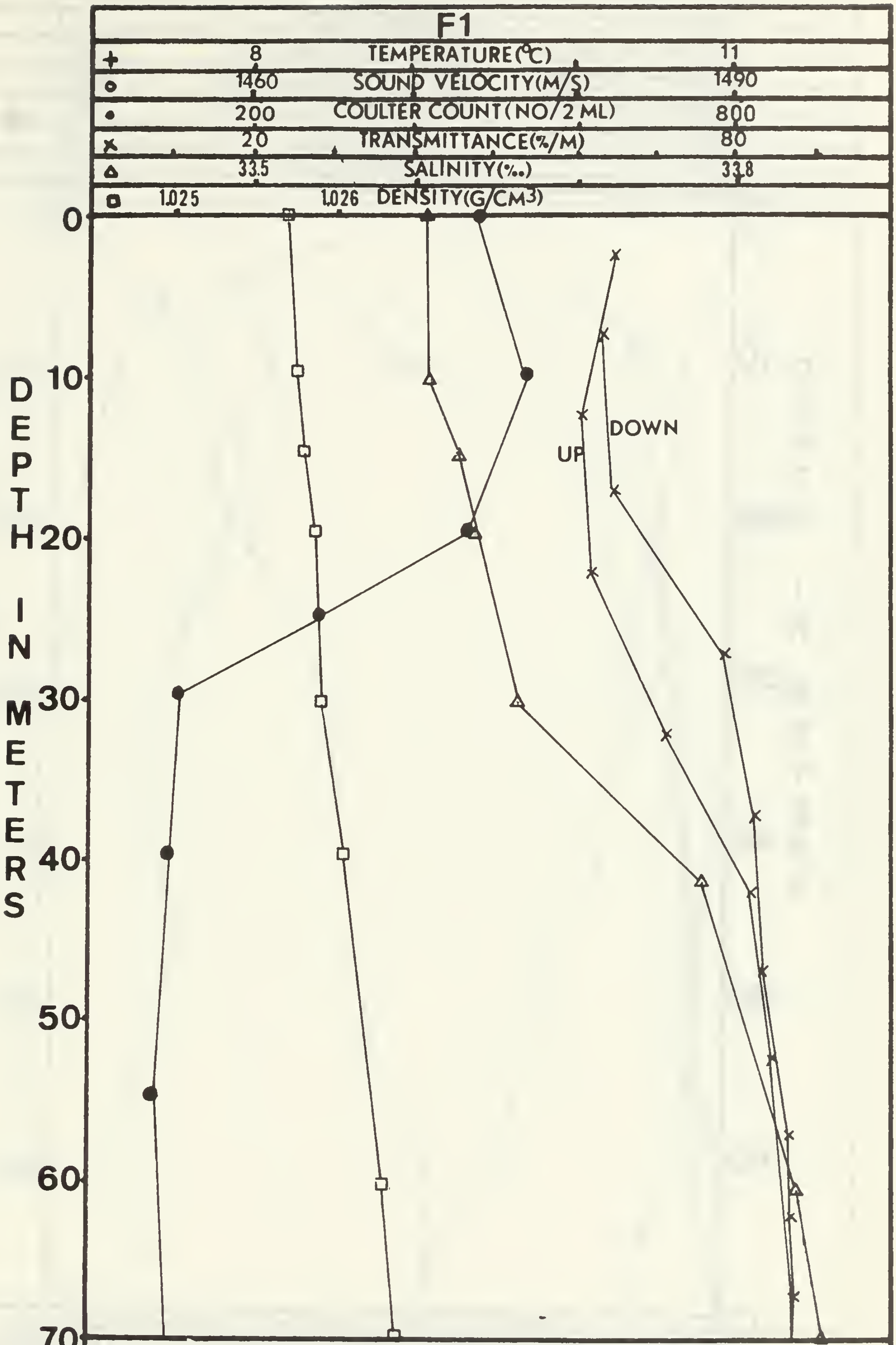

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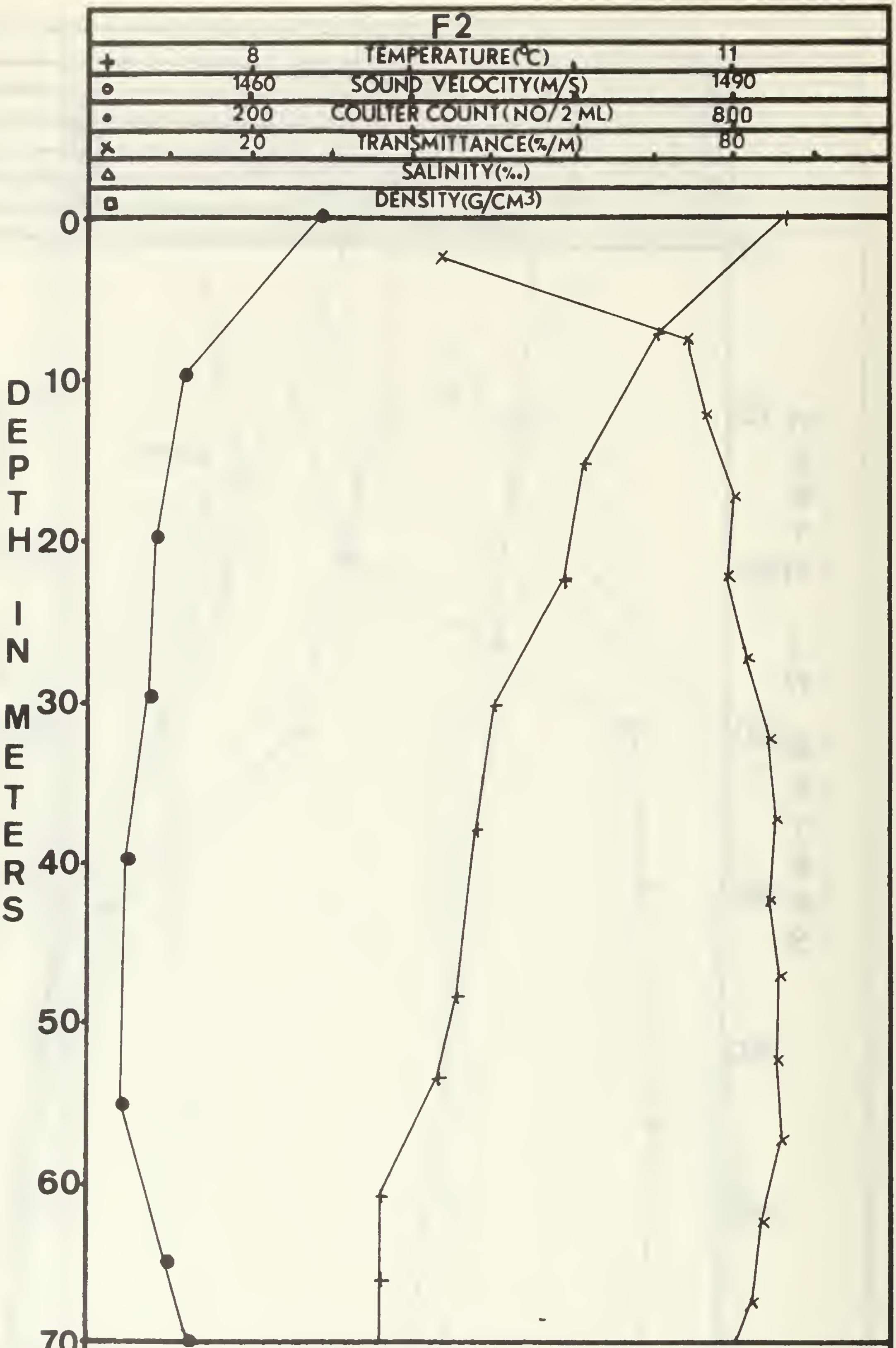

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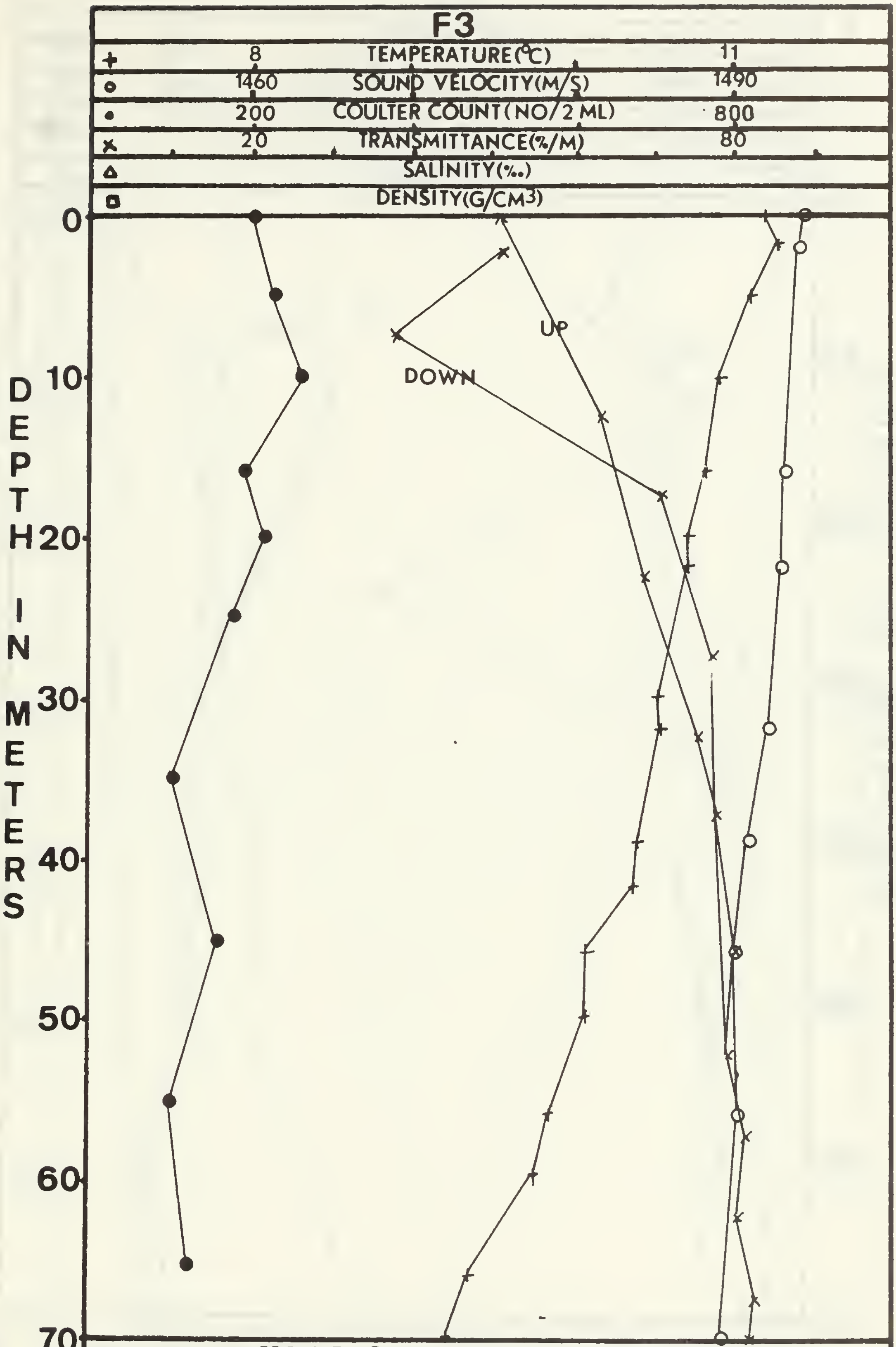

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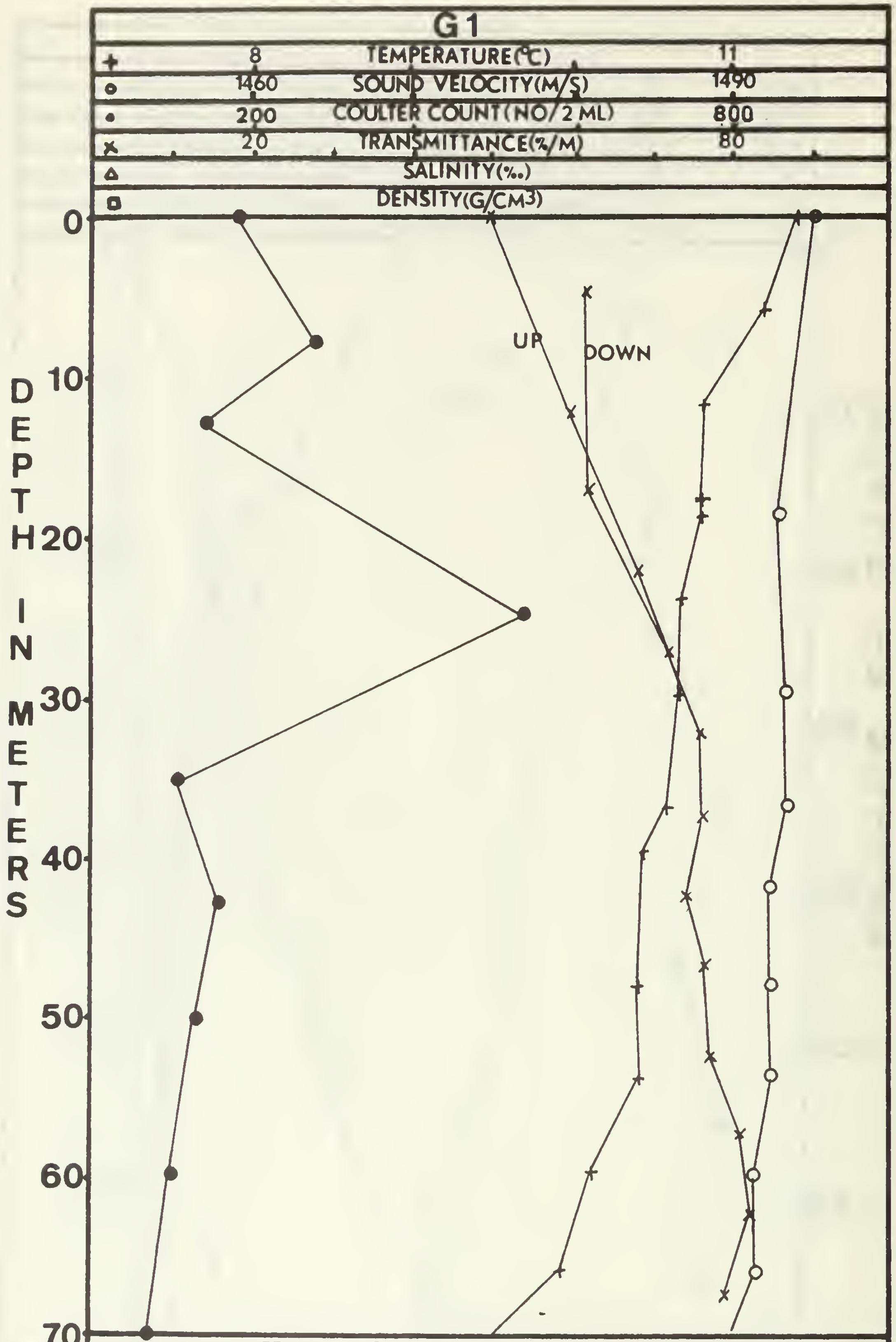

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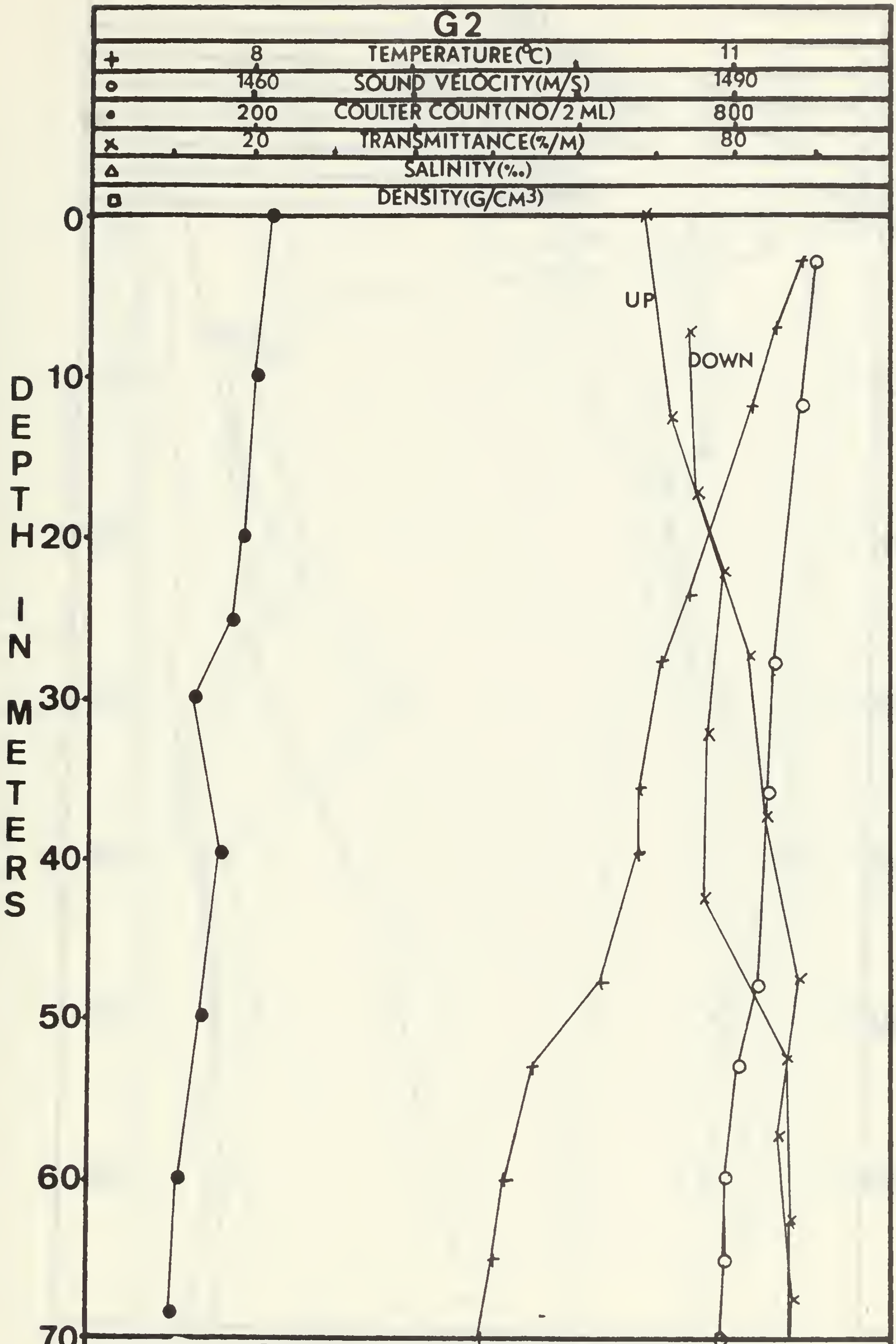

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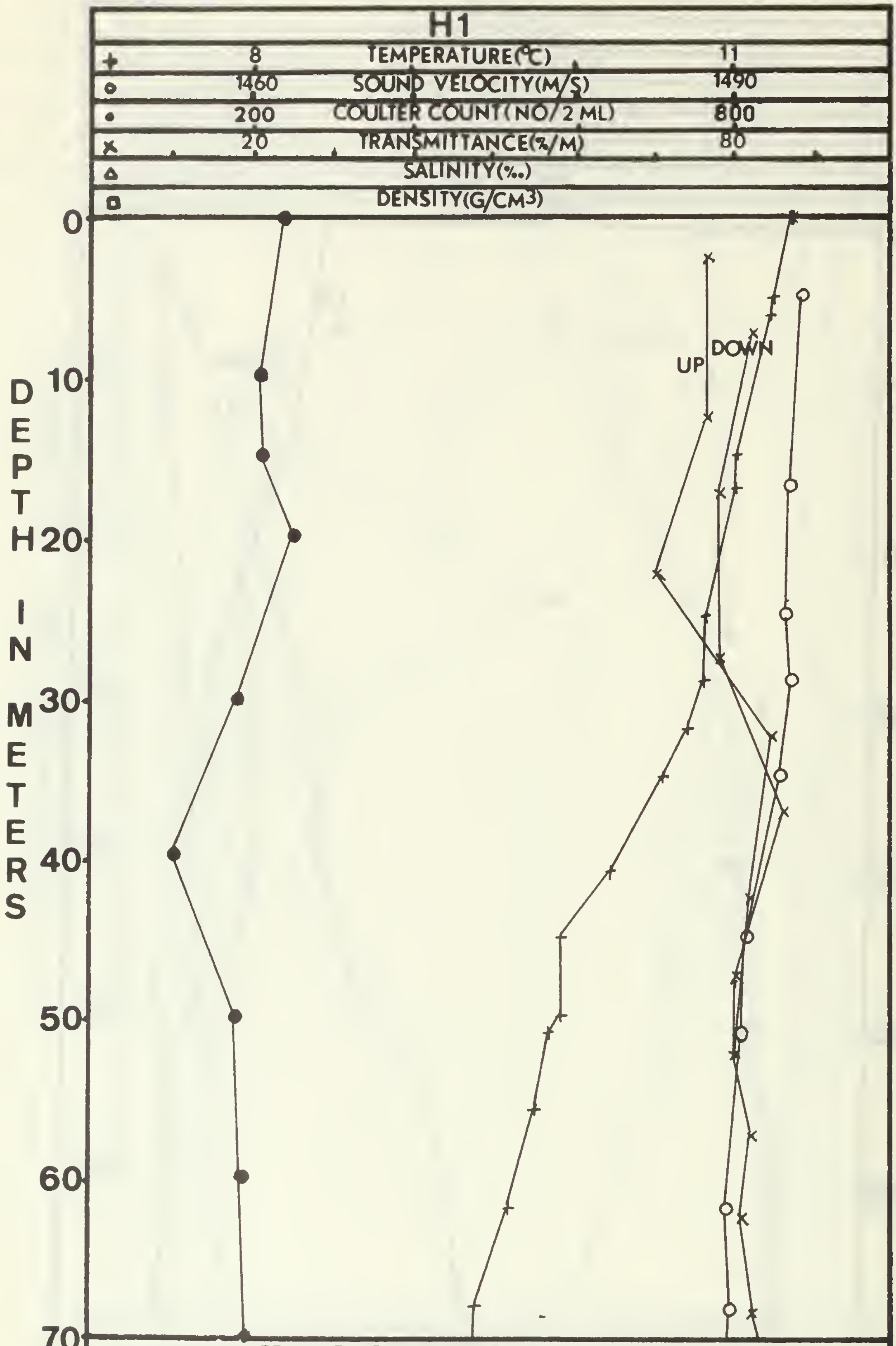

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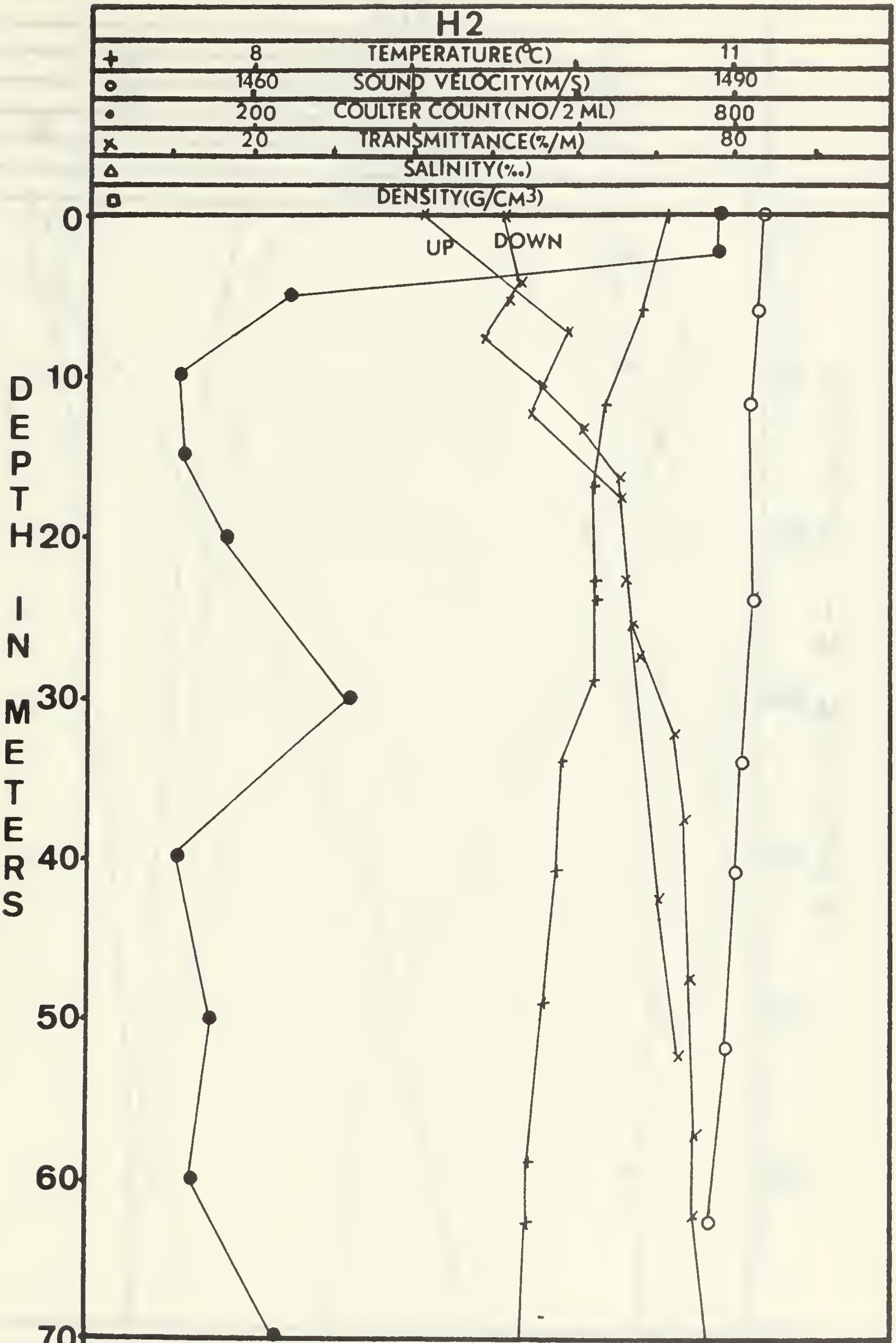

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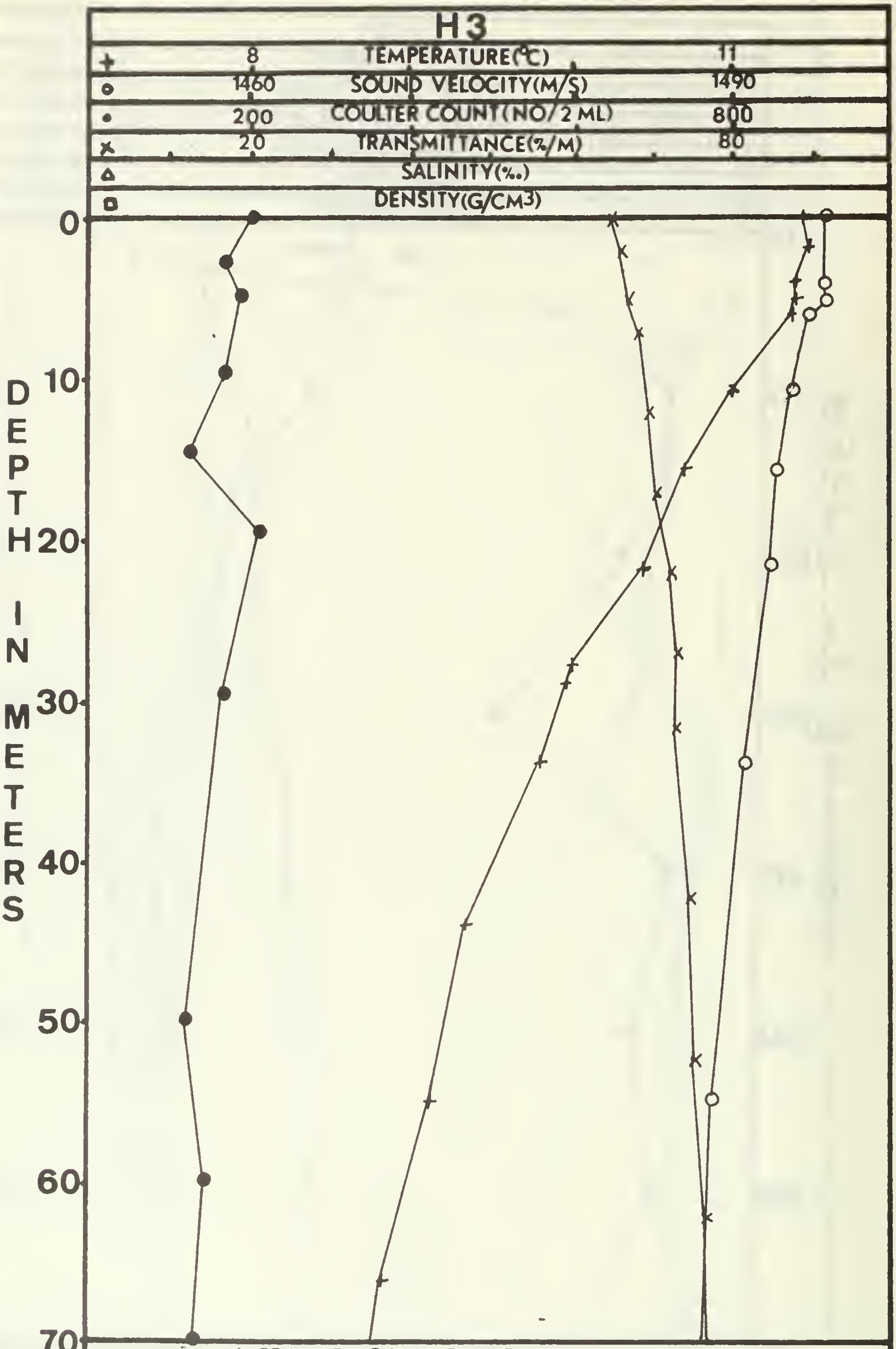

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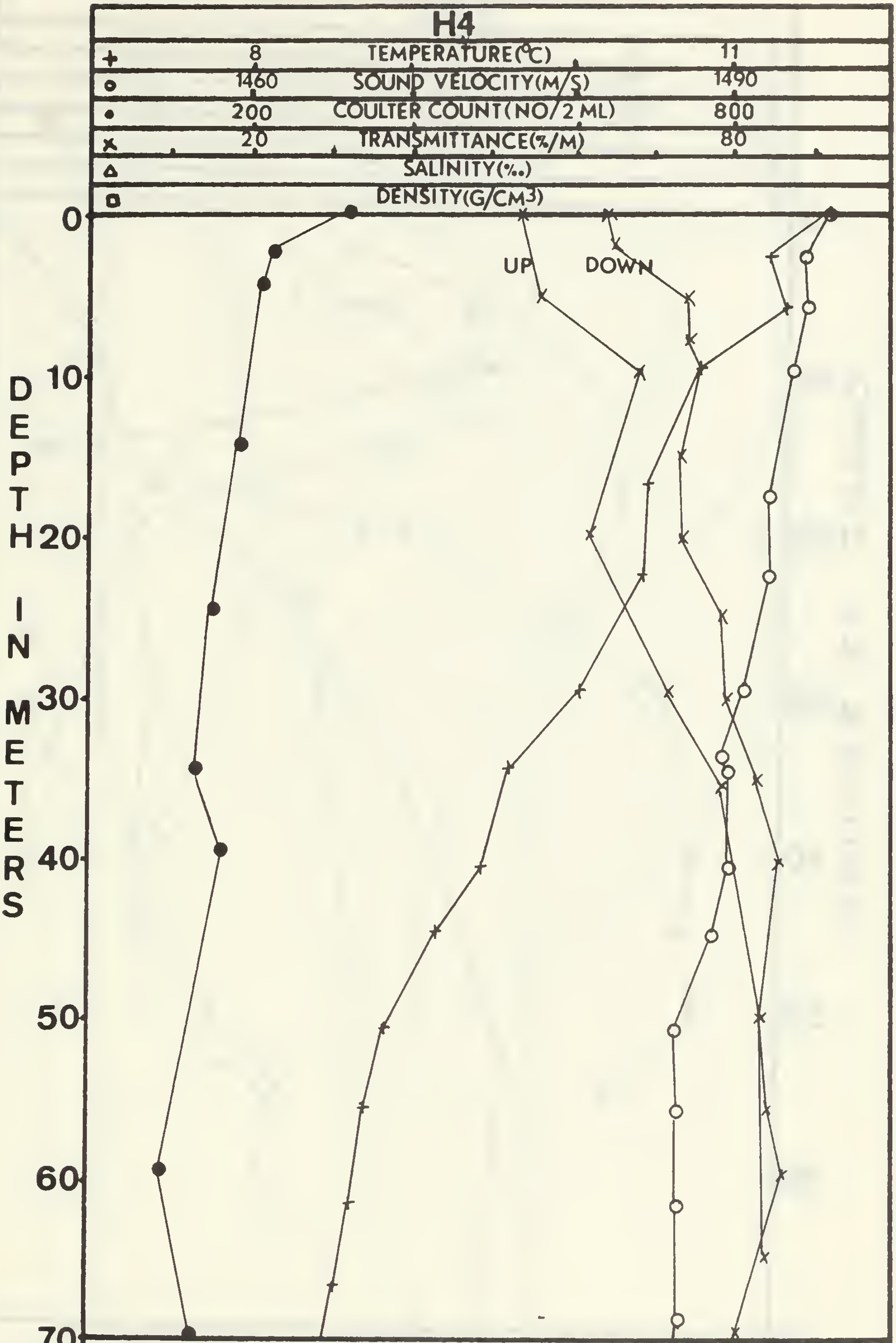

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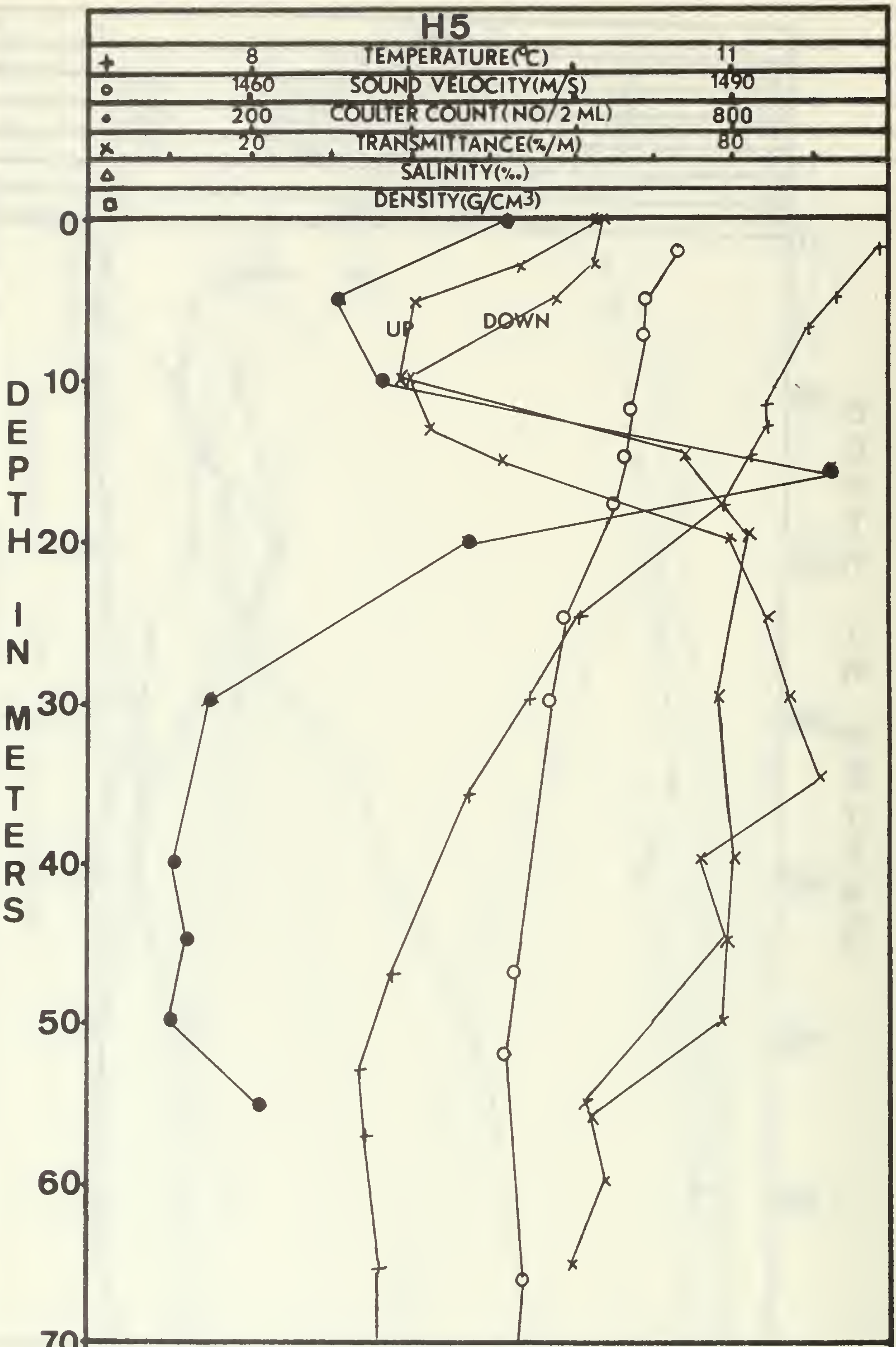

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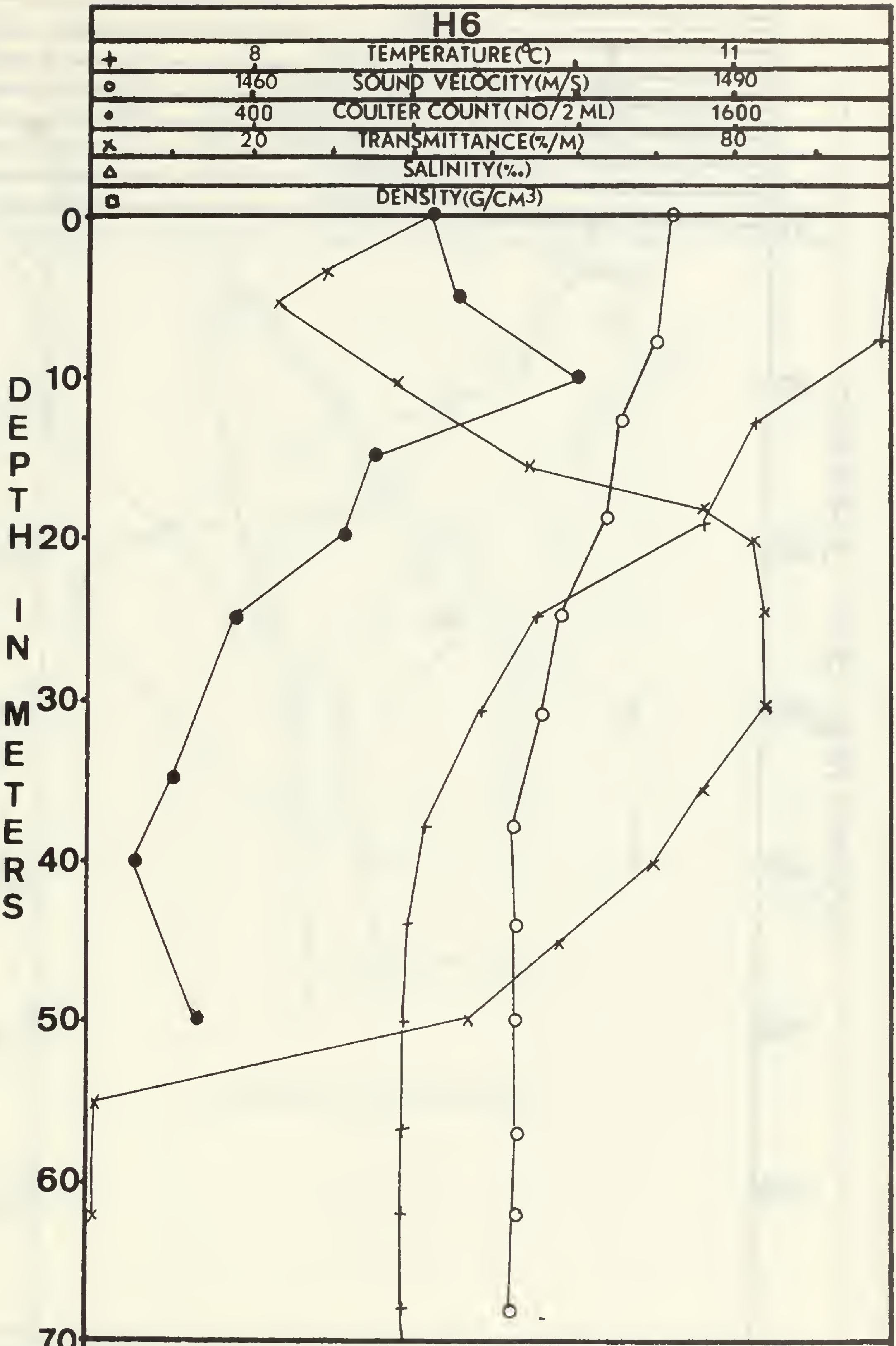

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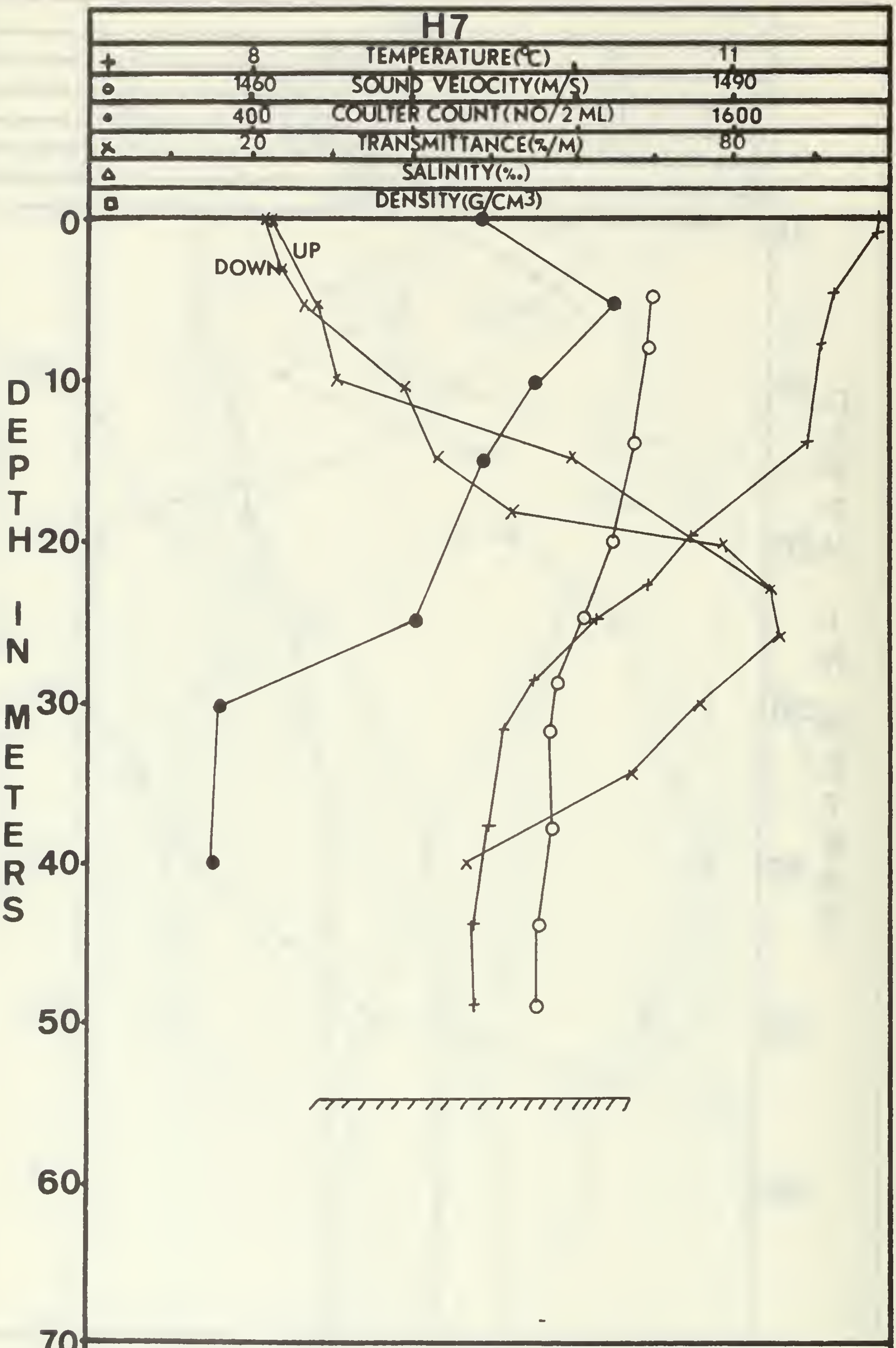

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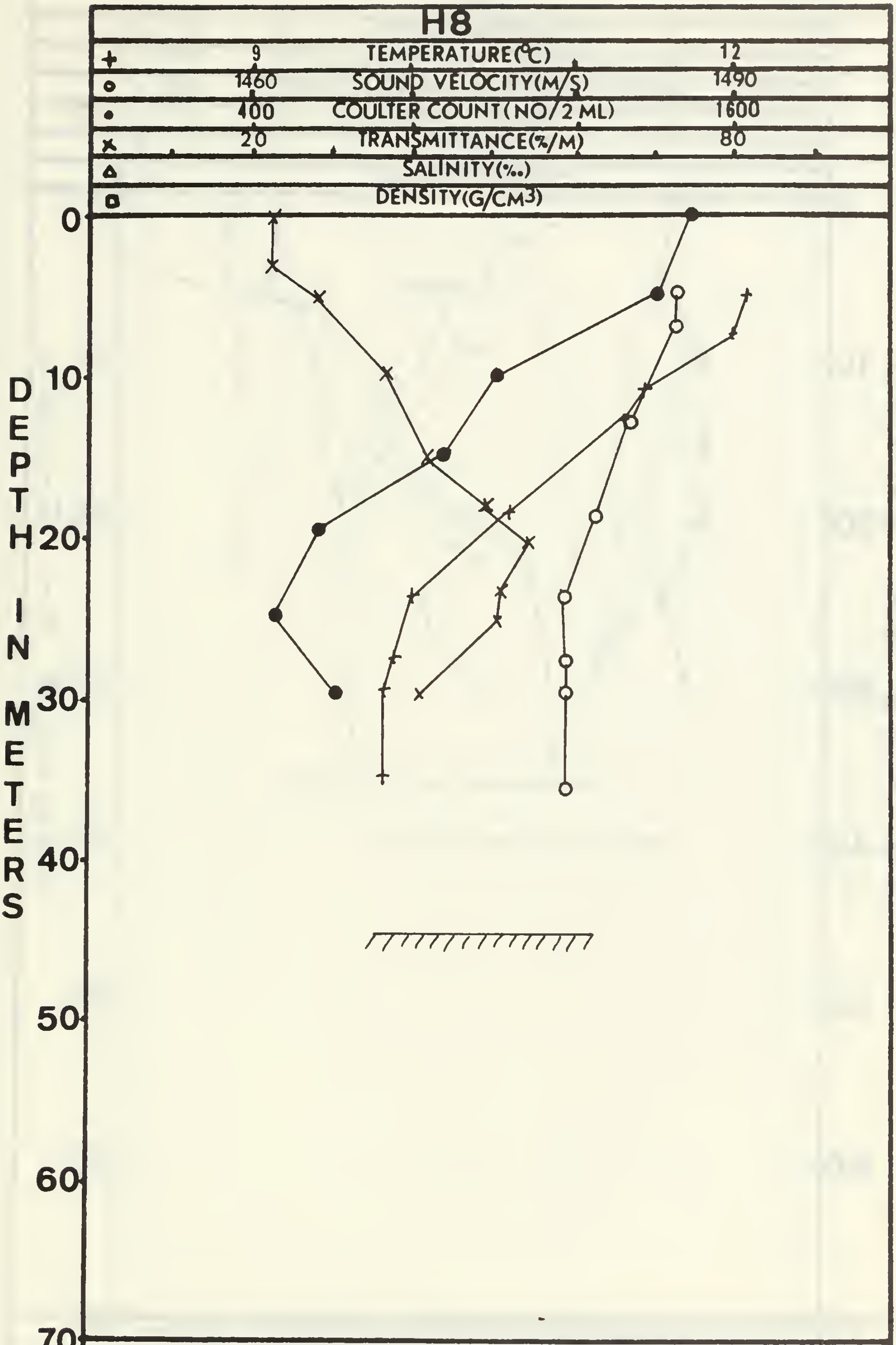

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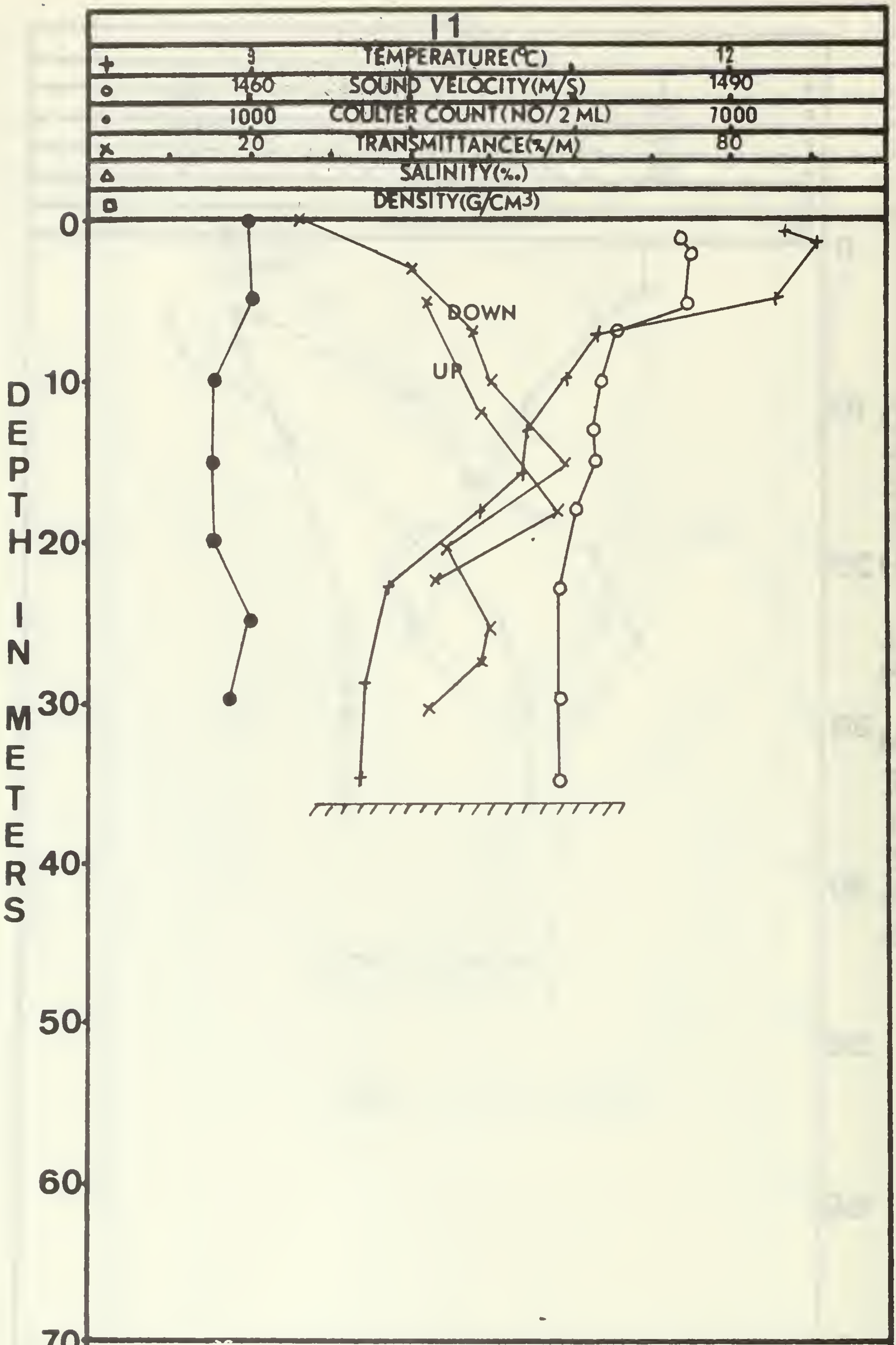

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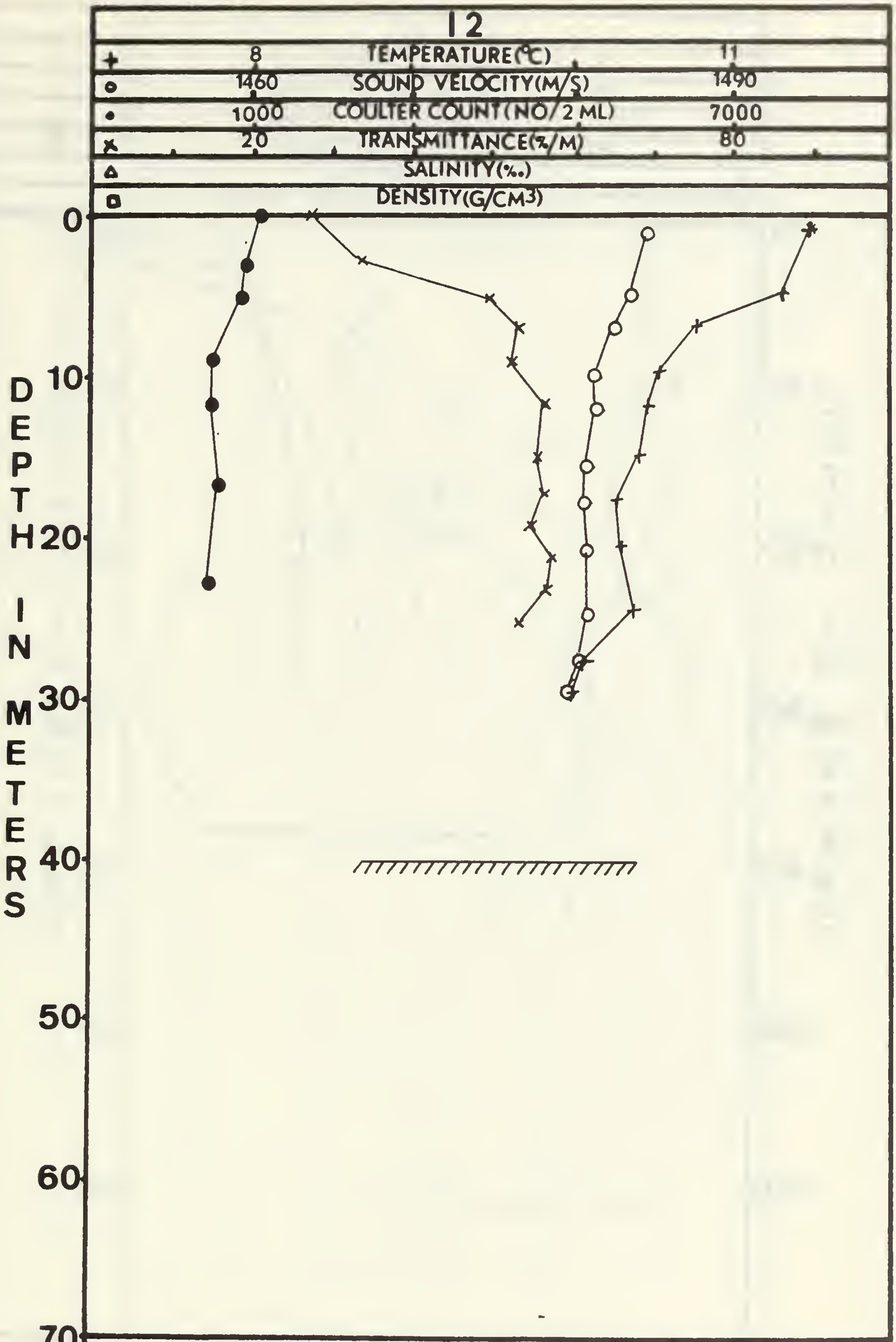

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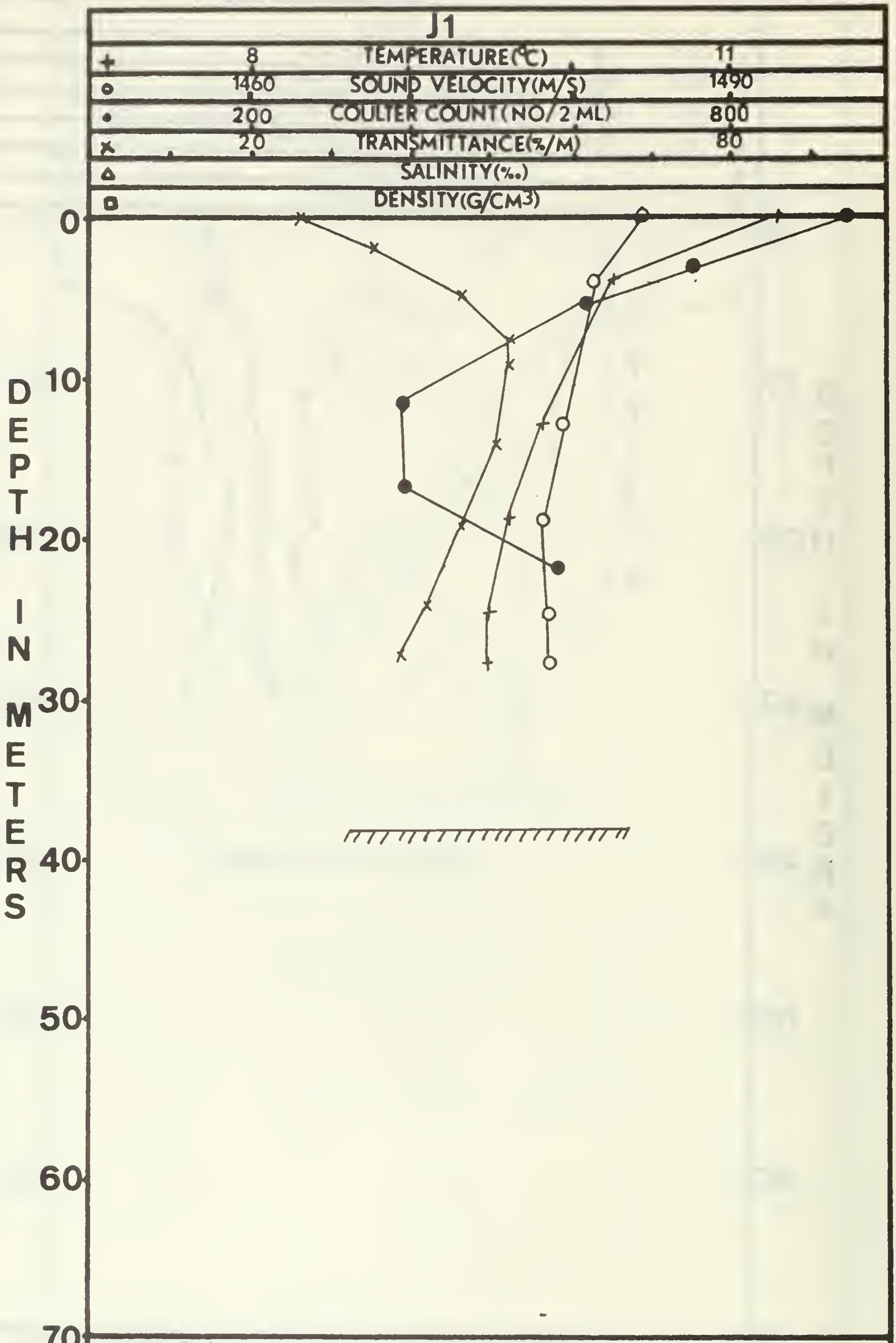

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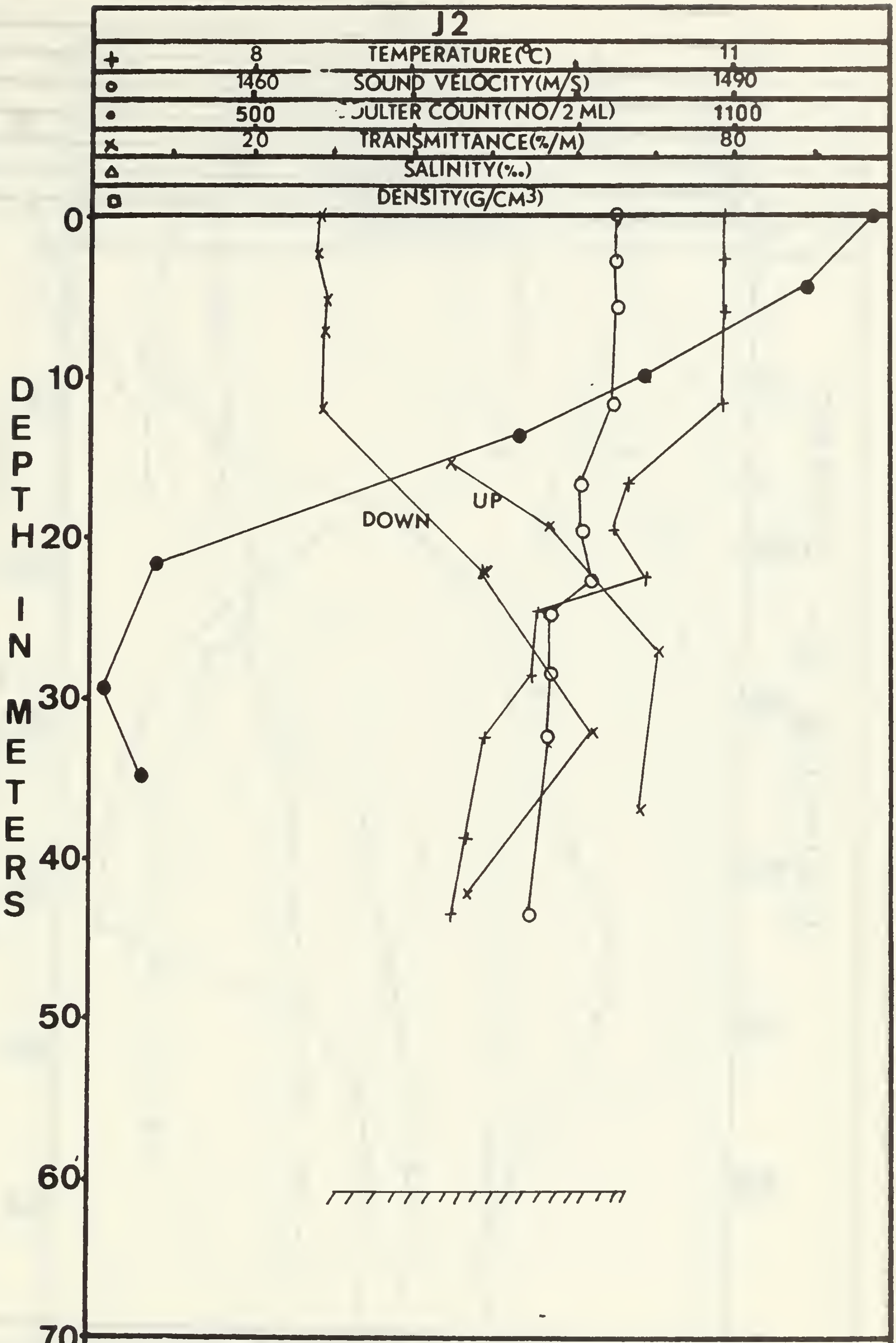

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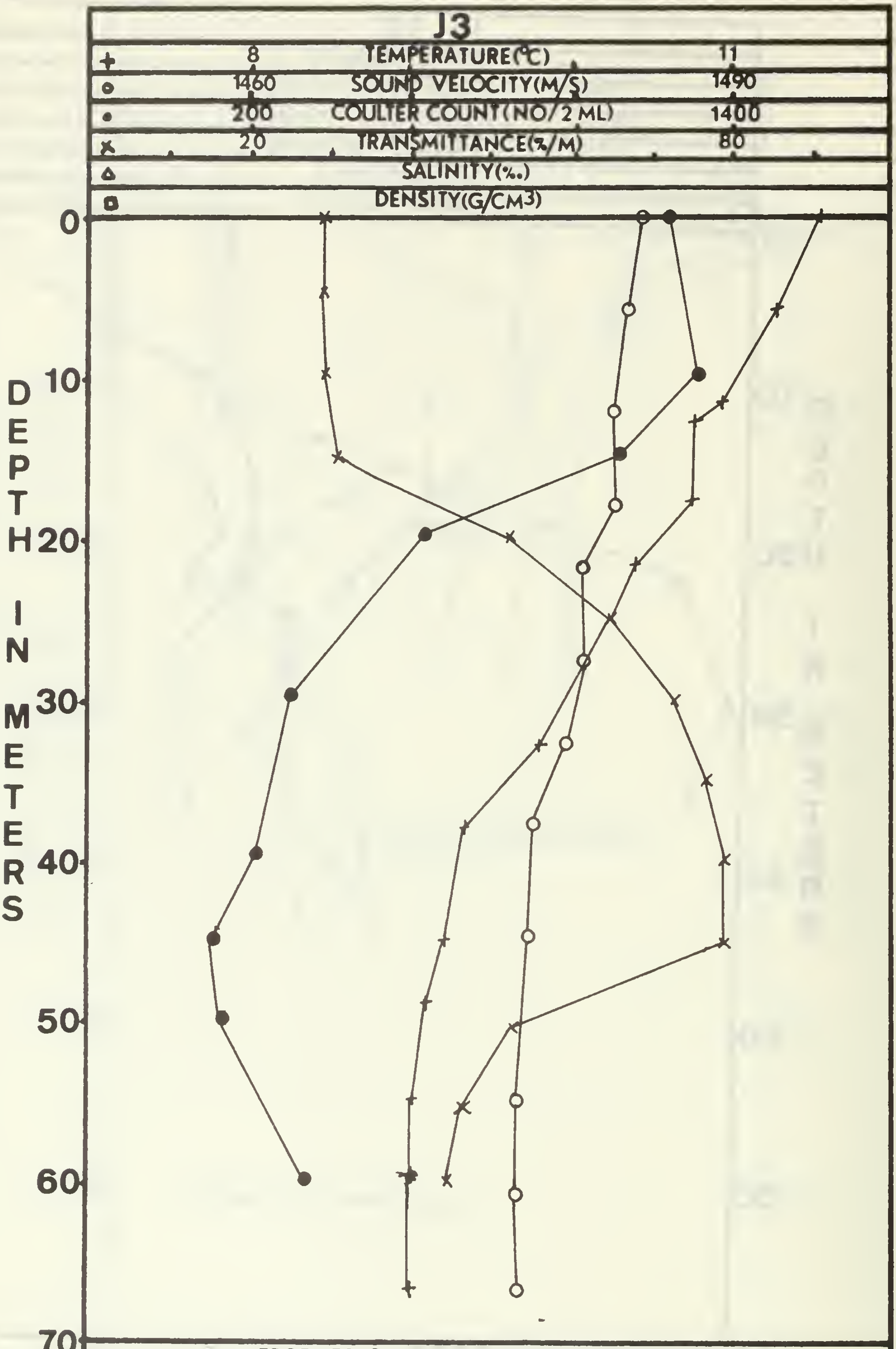

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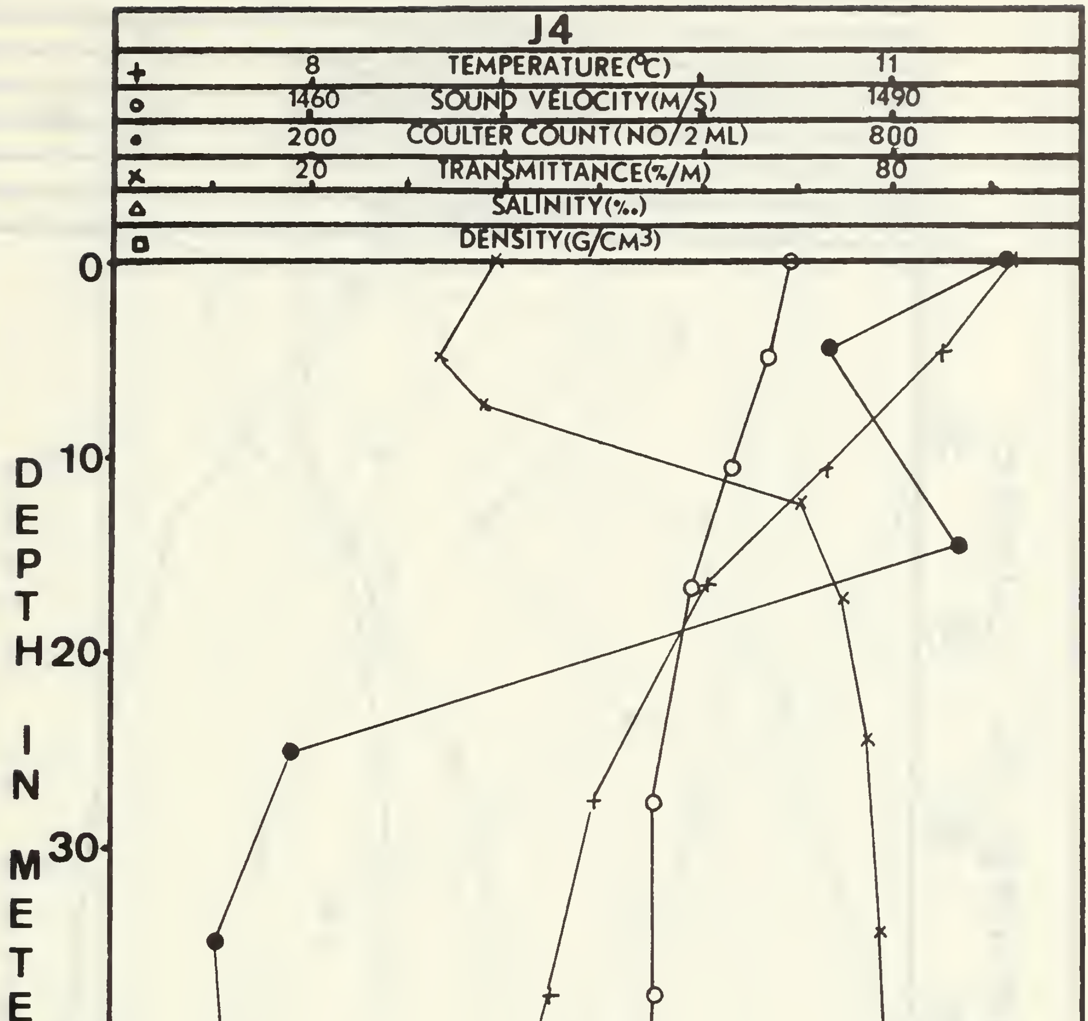

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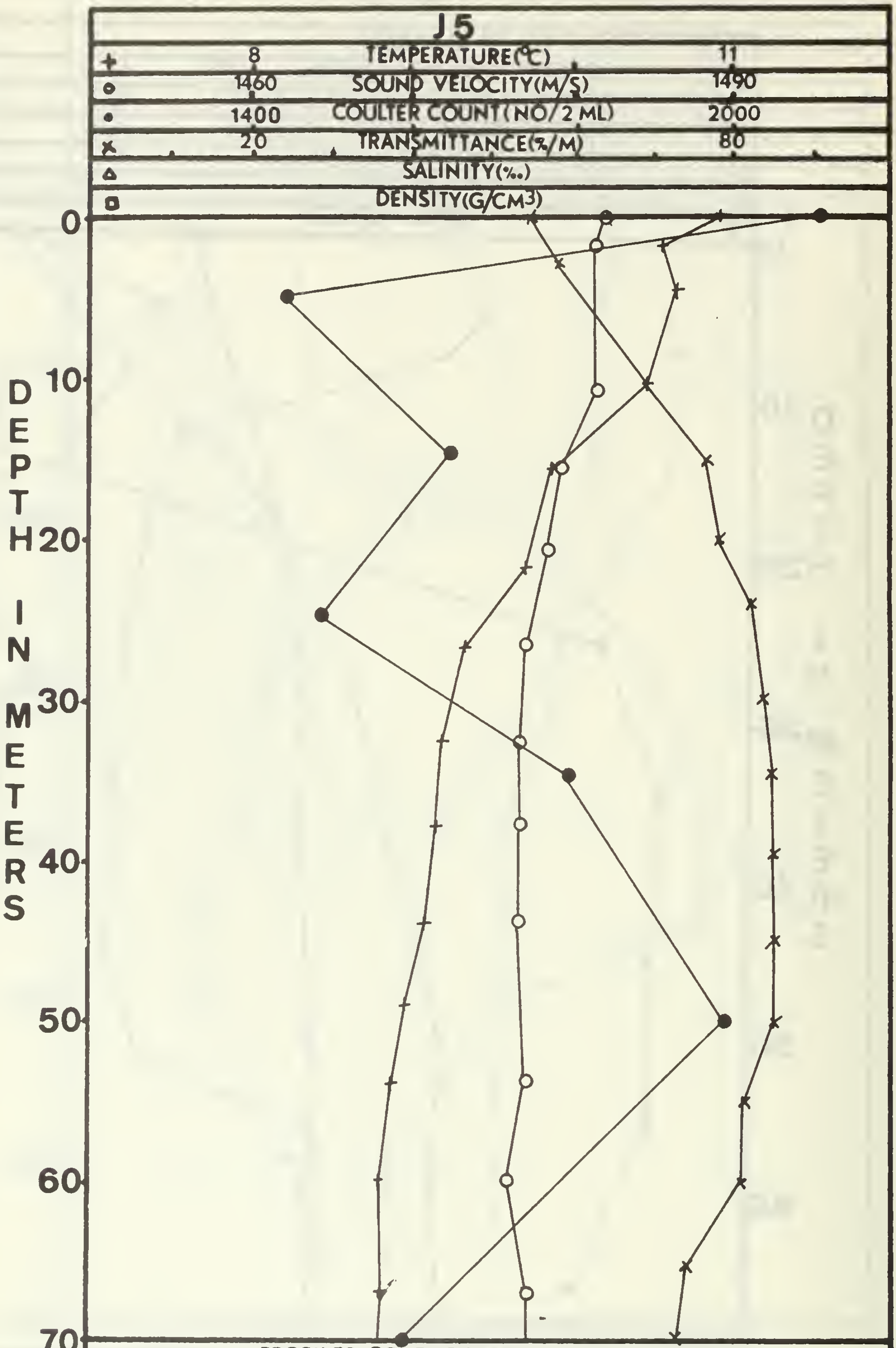

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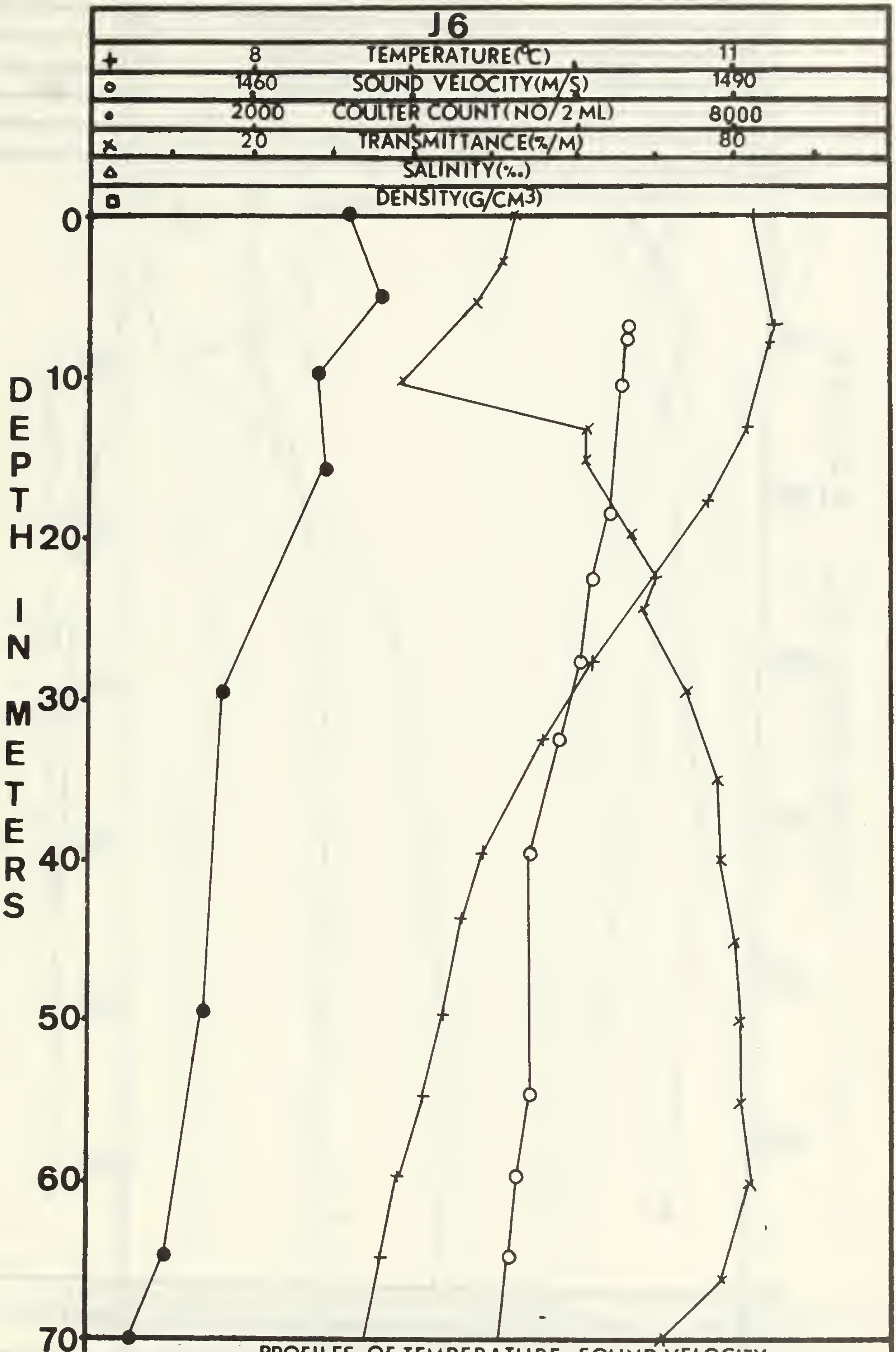

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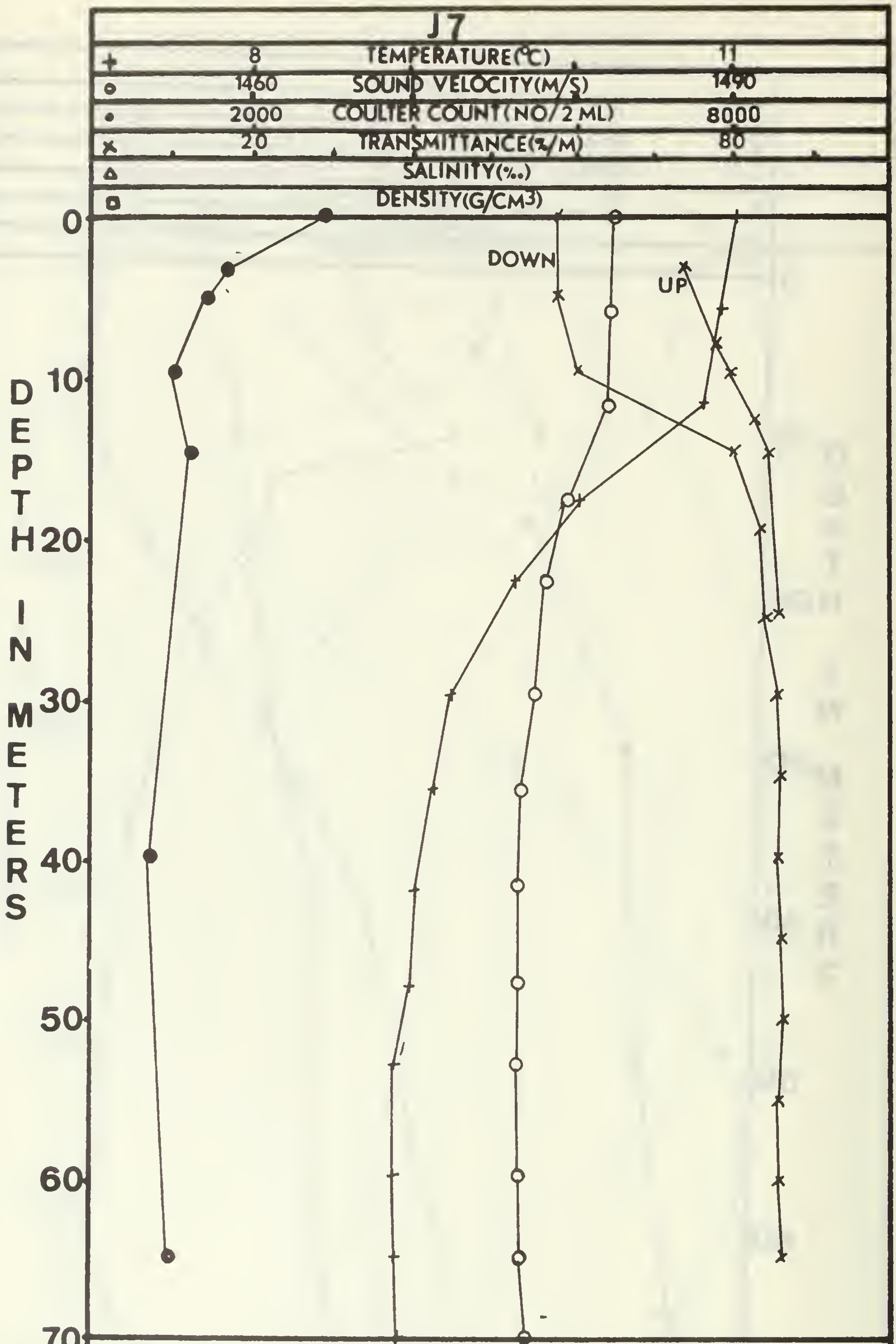

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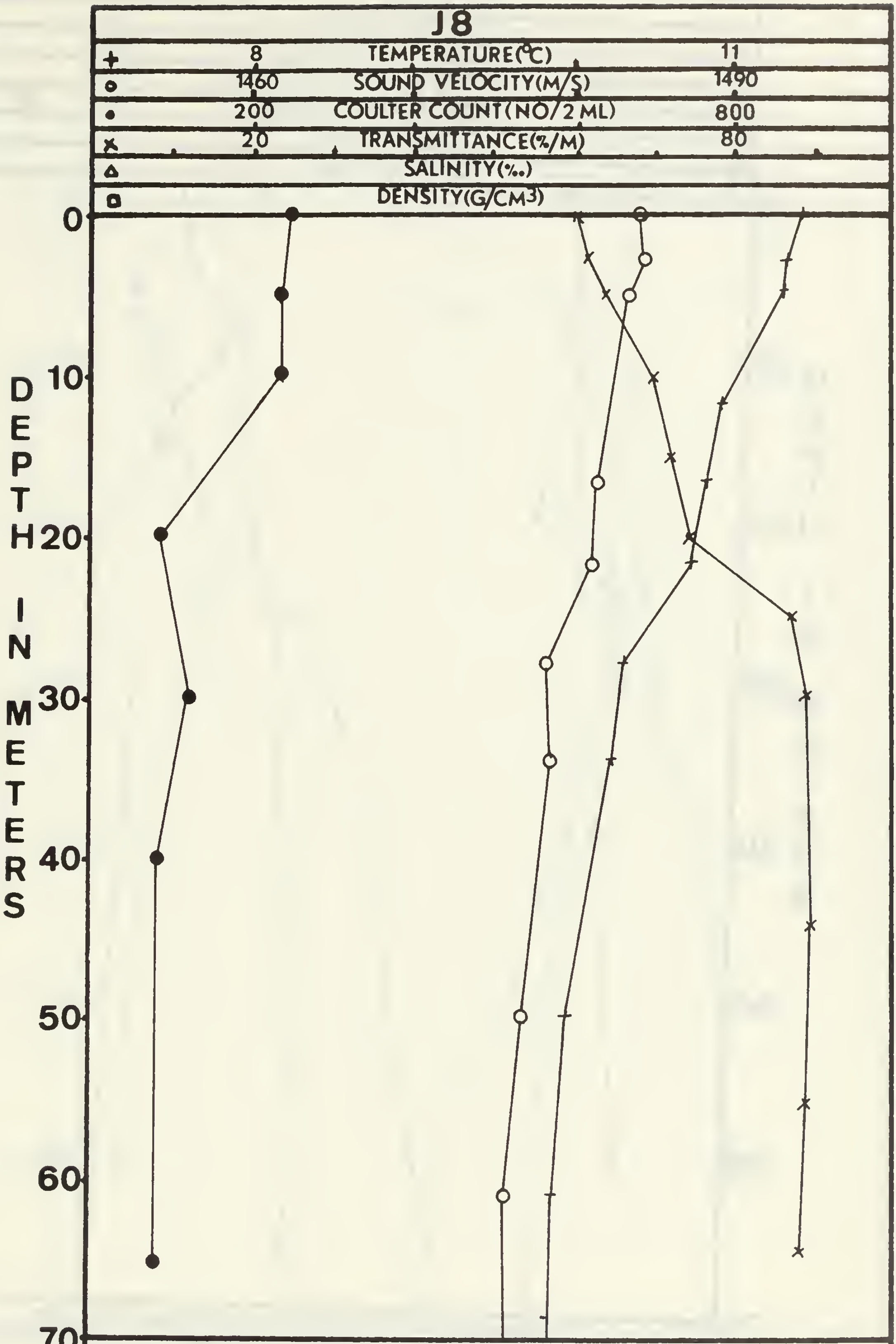

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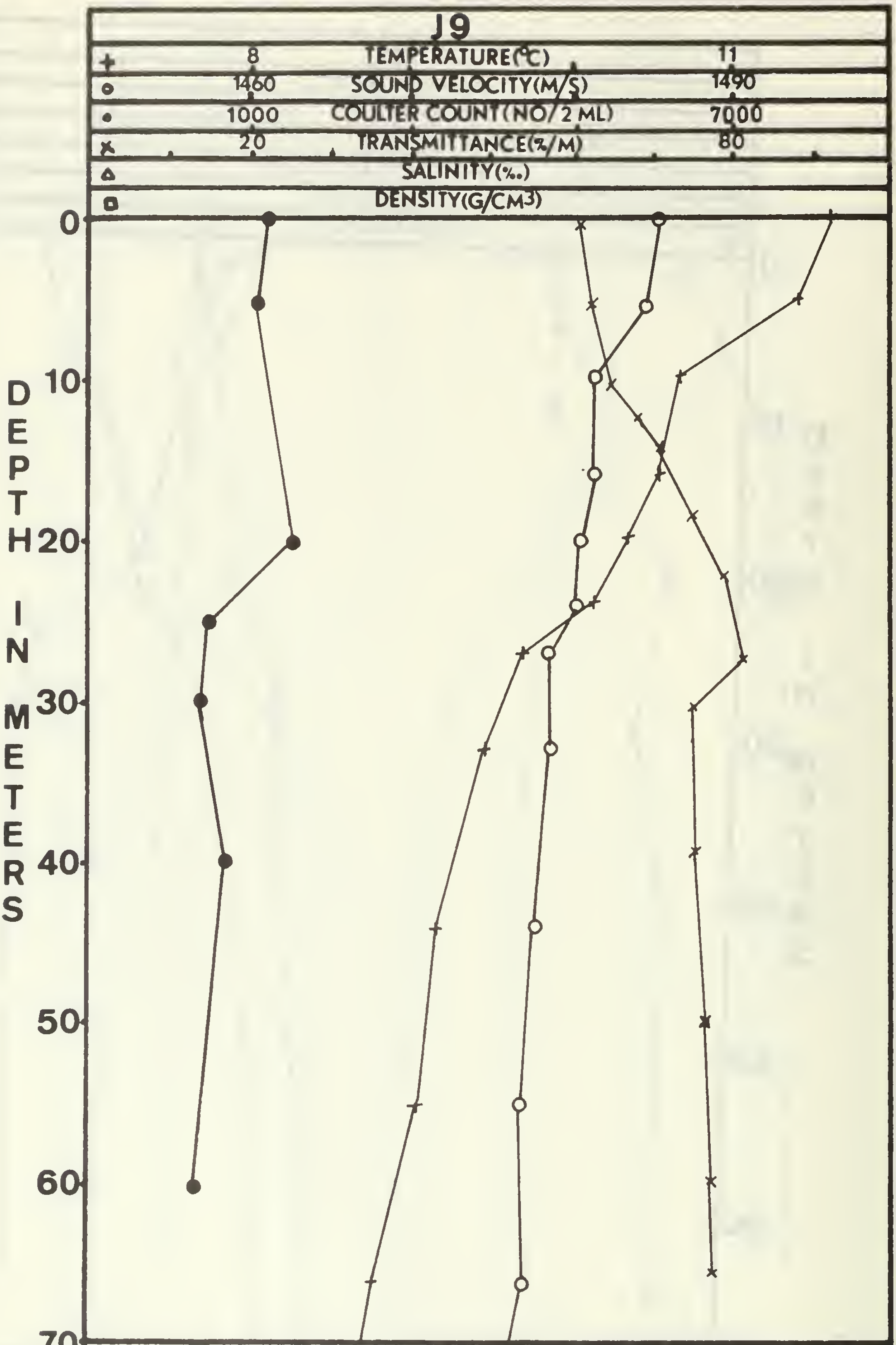

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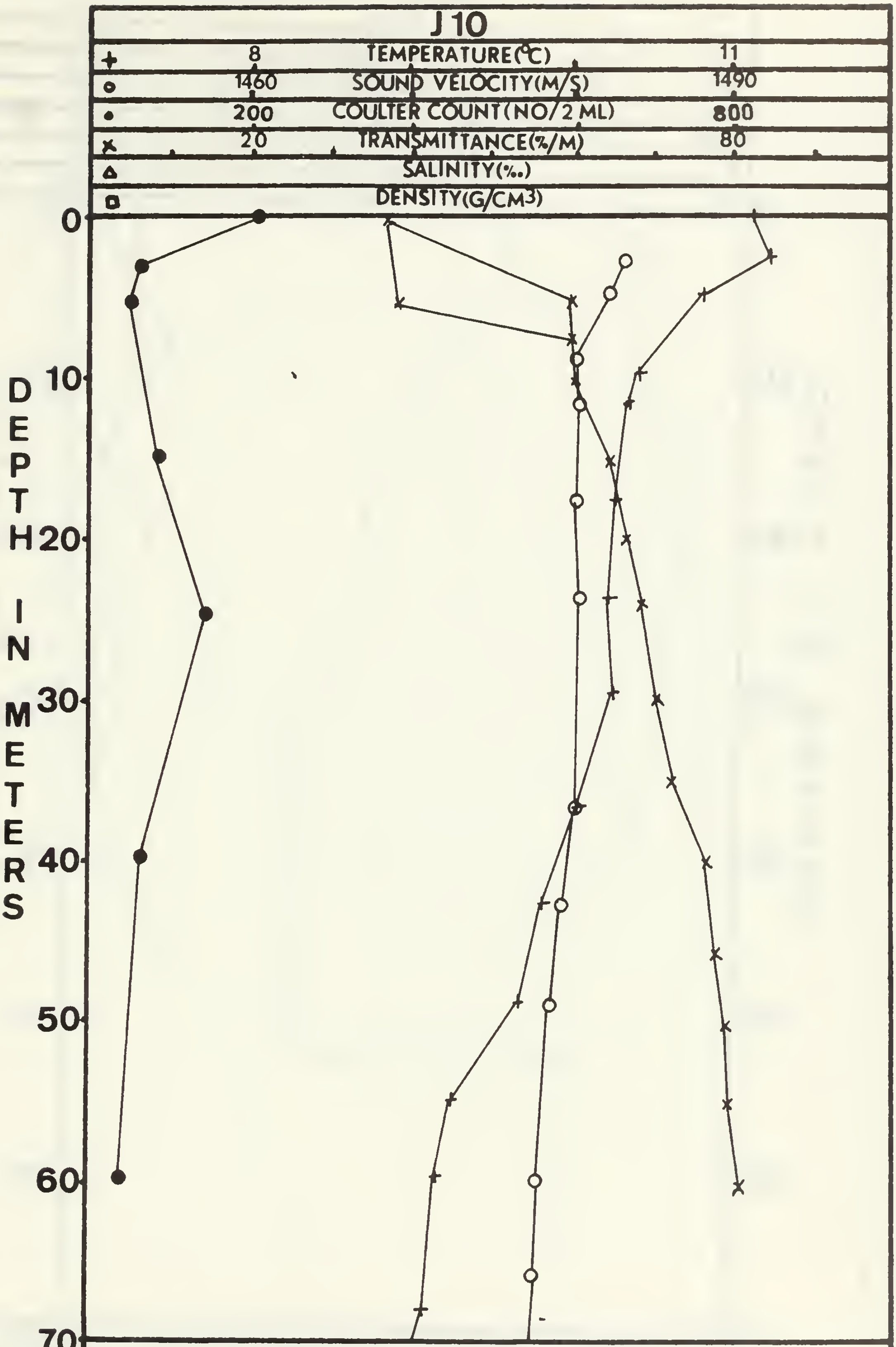

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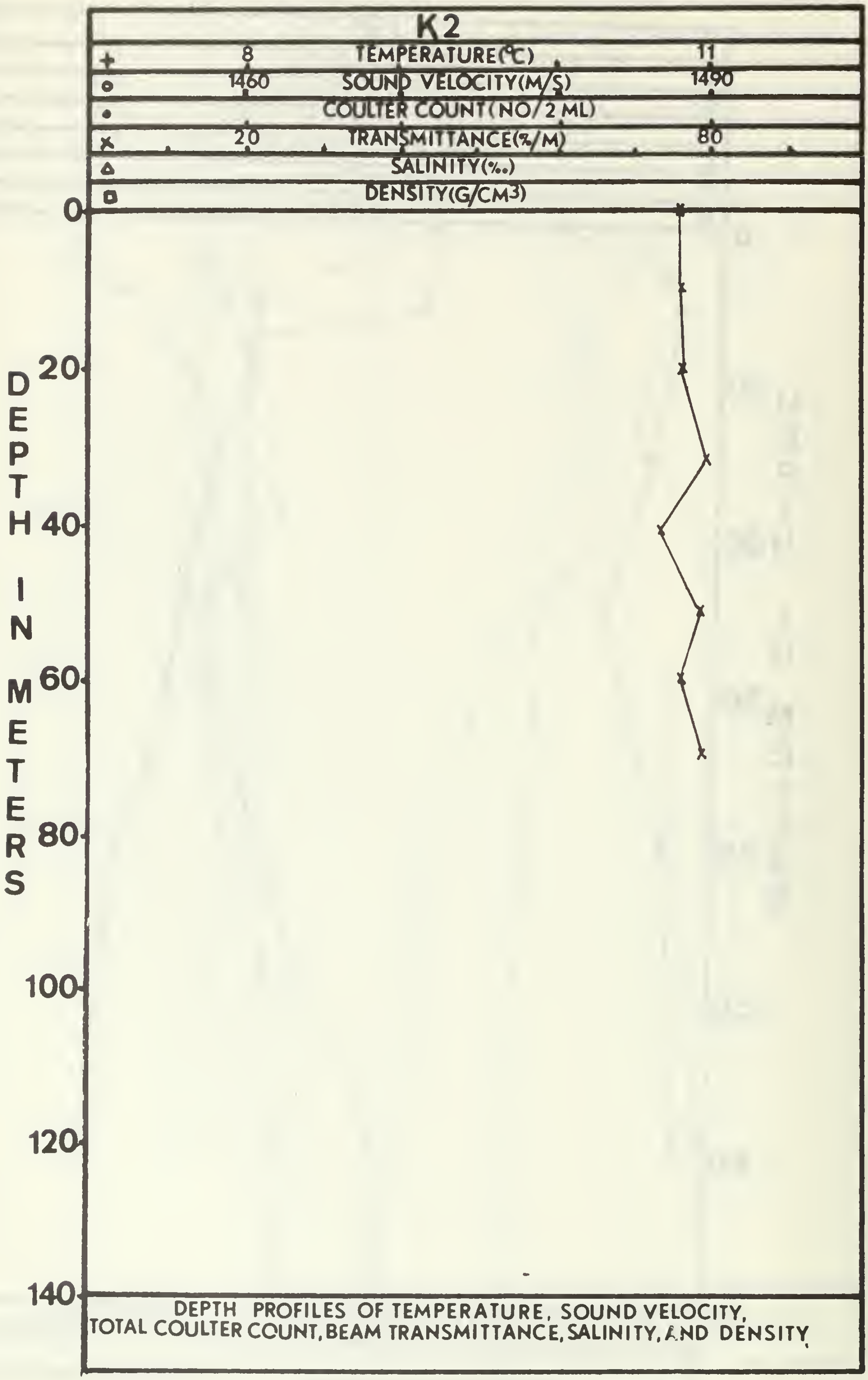
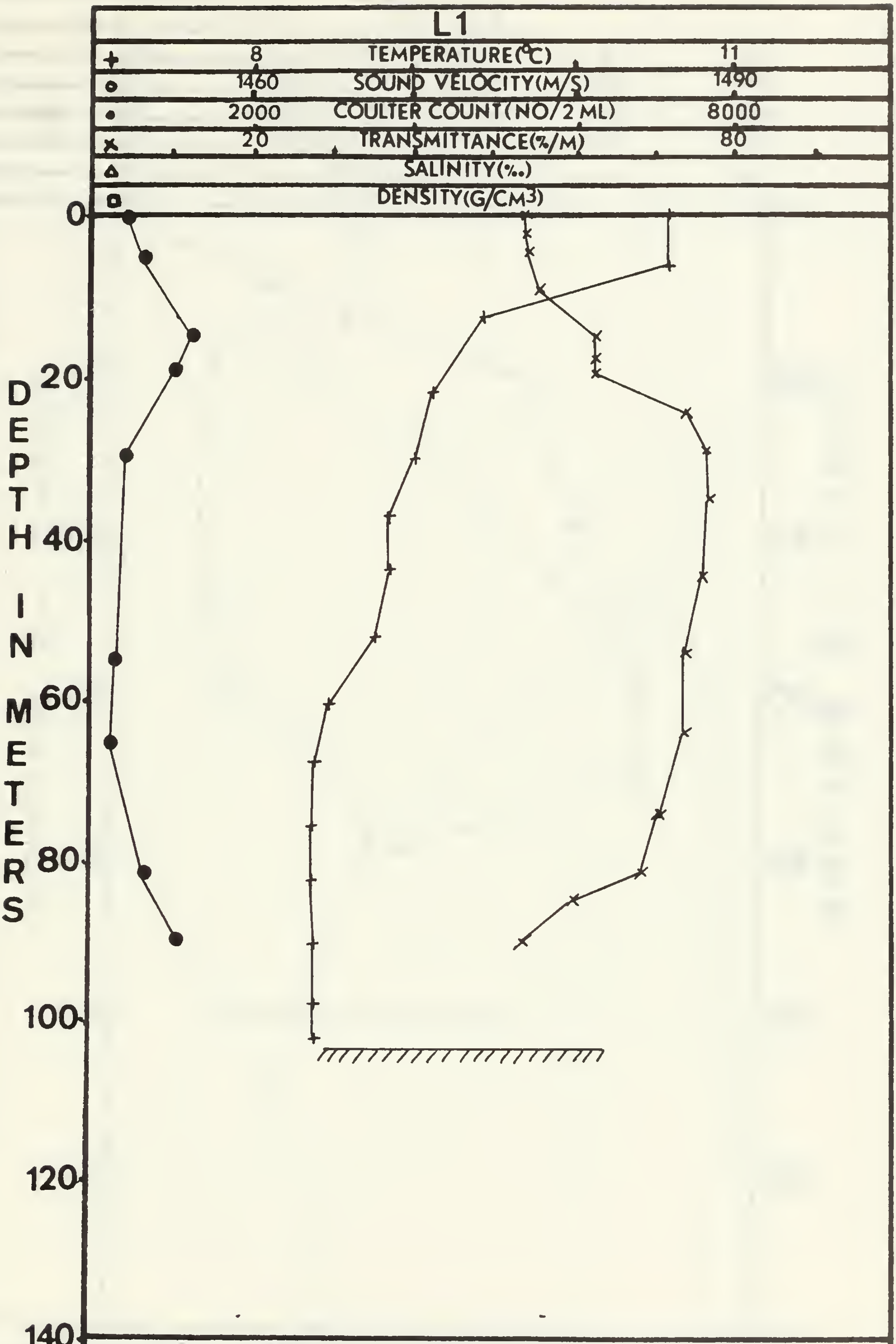
TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



DEPTH PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



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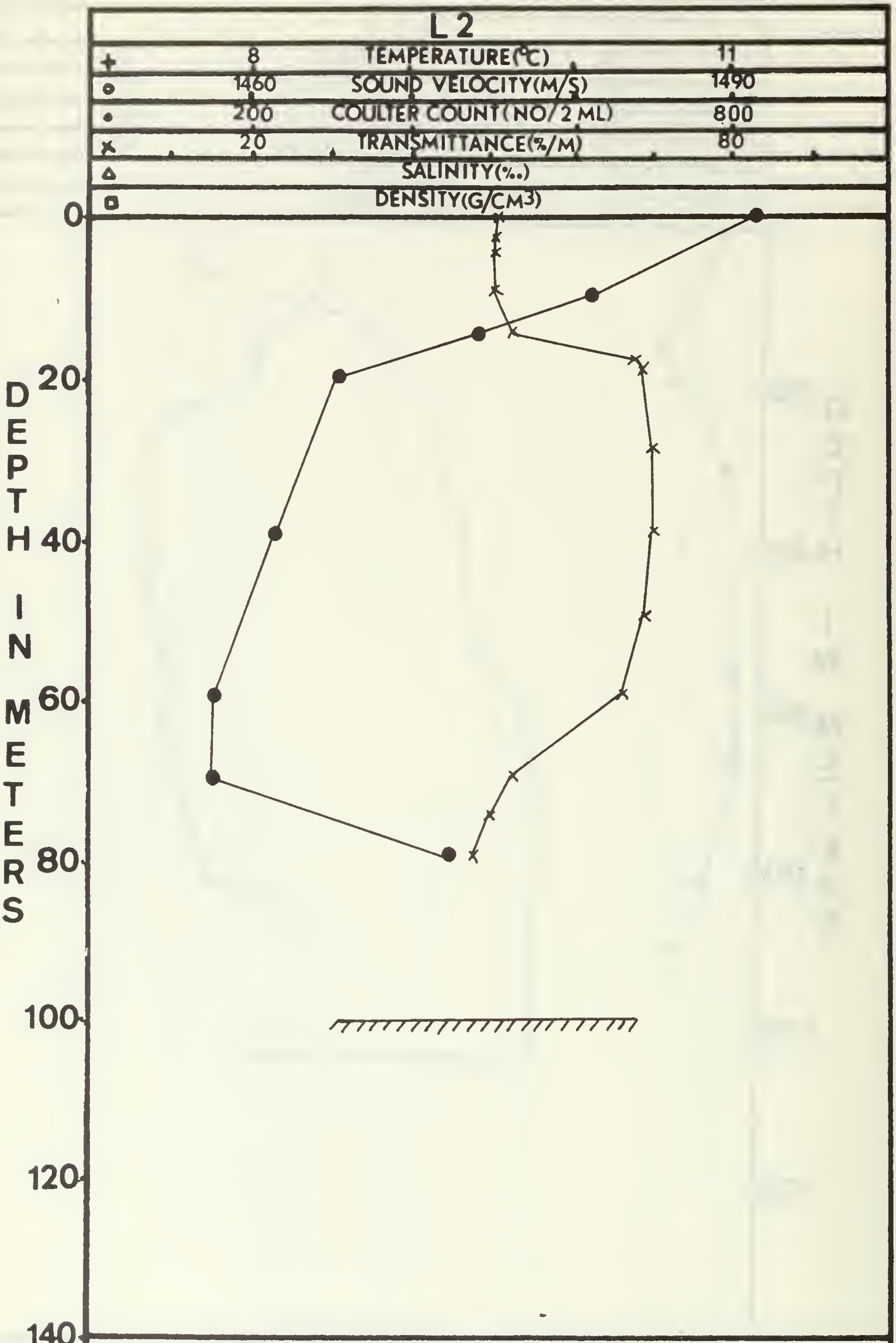

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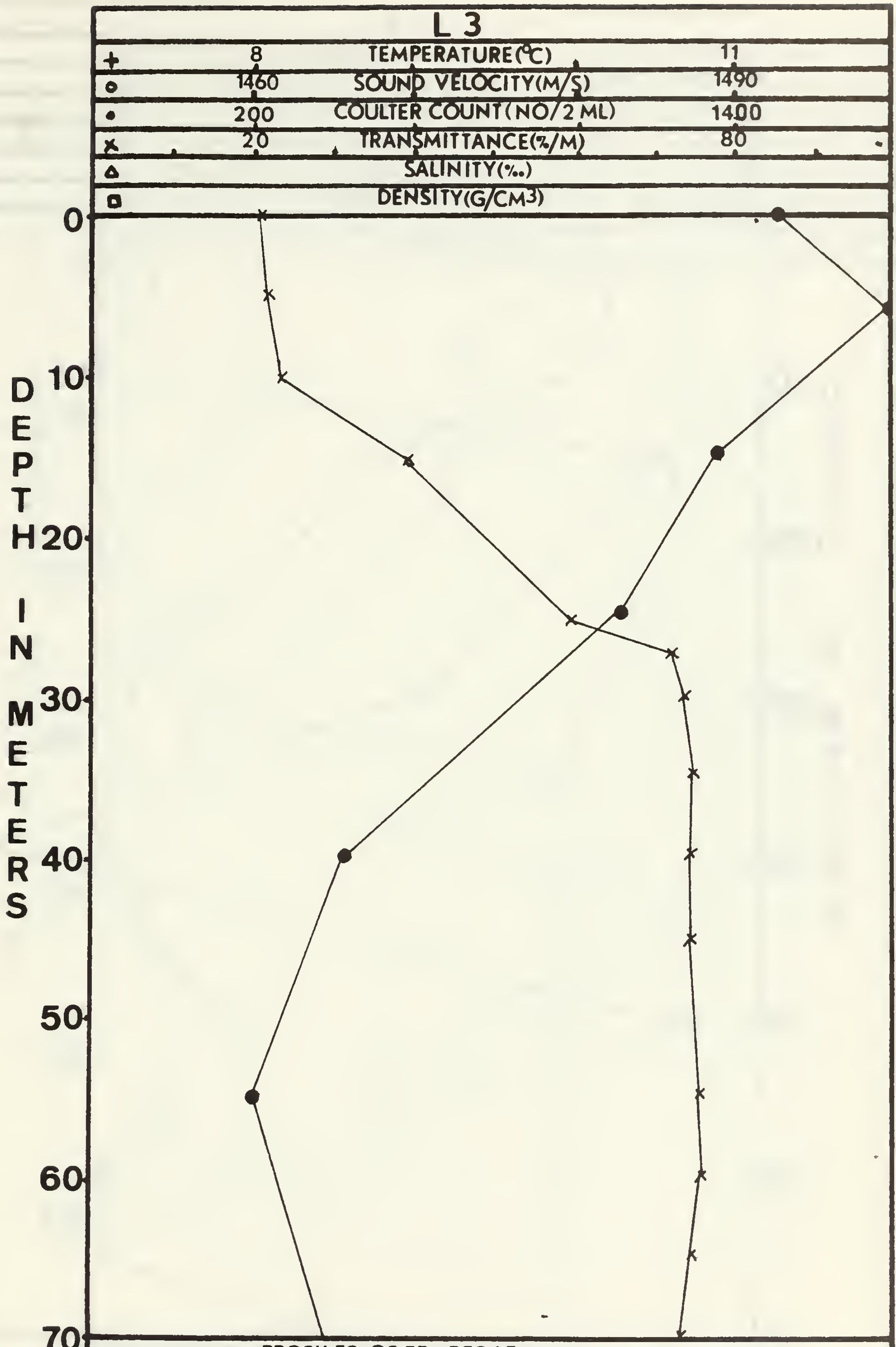

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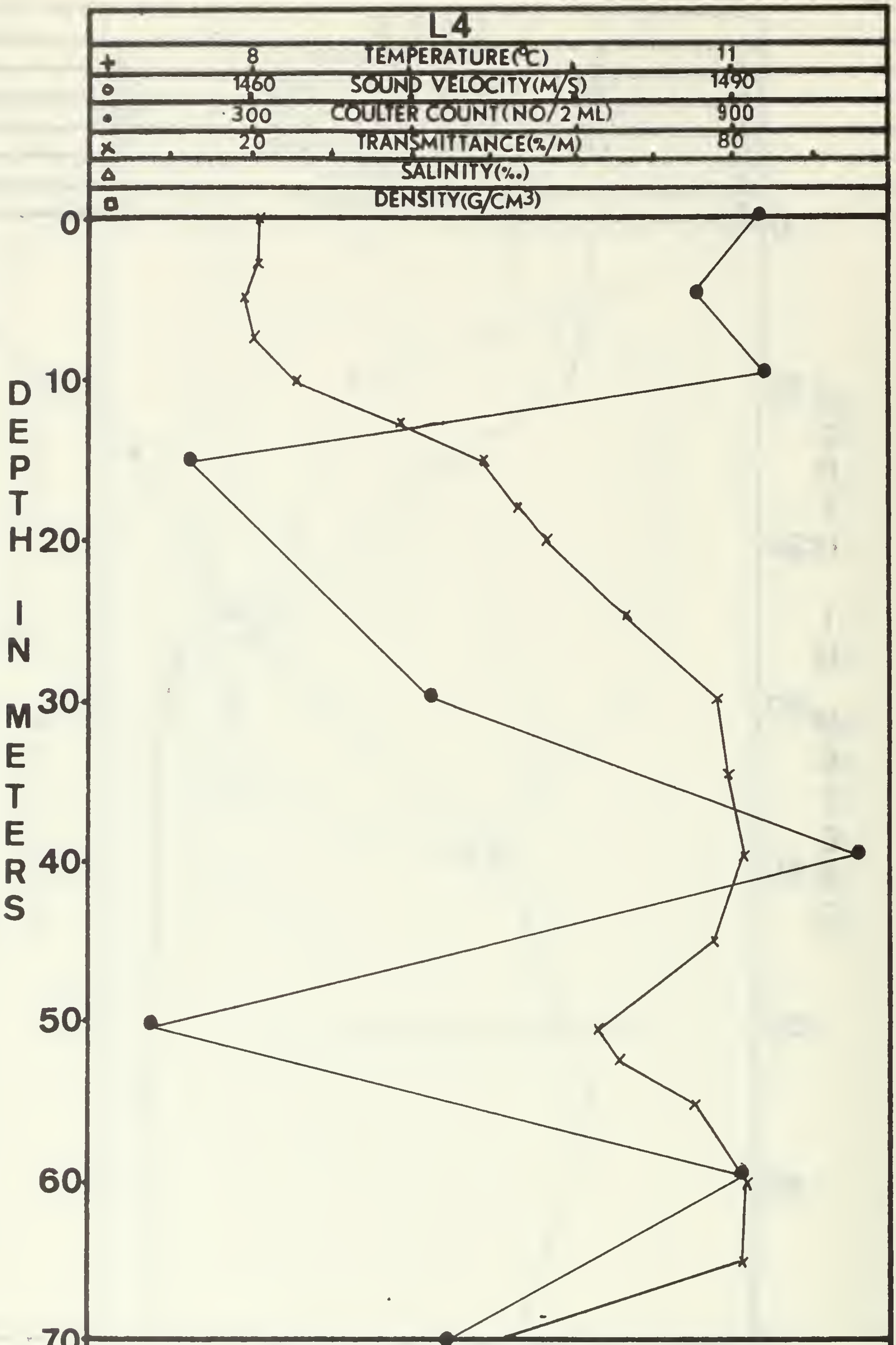

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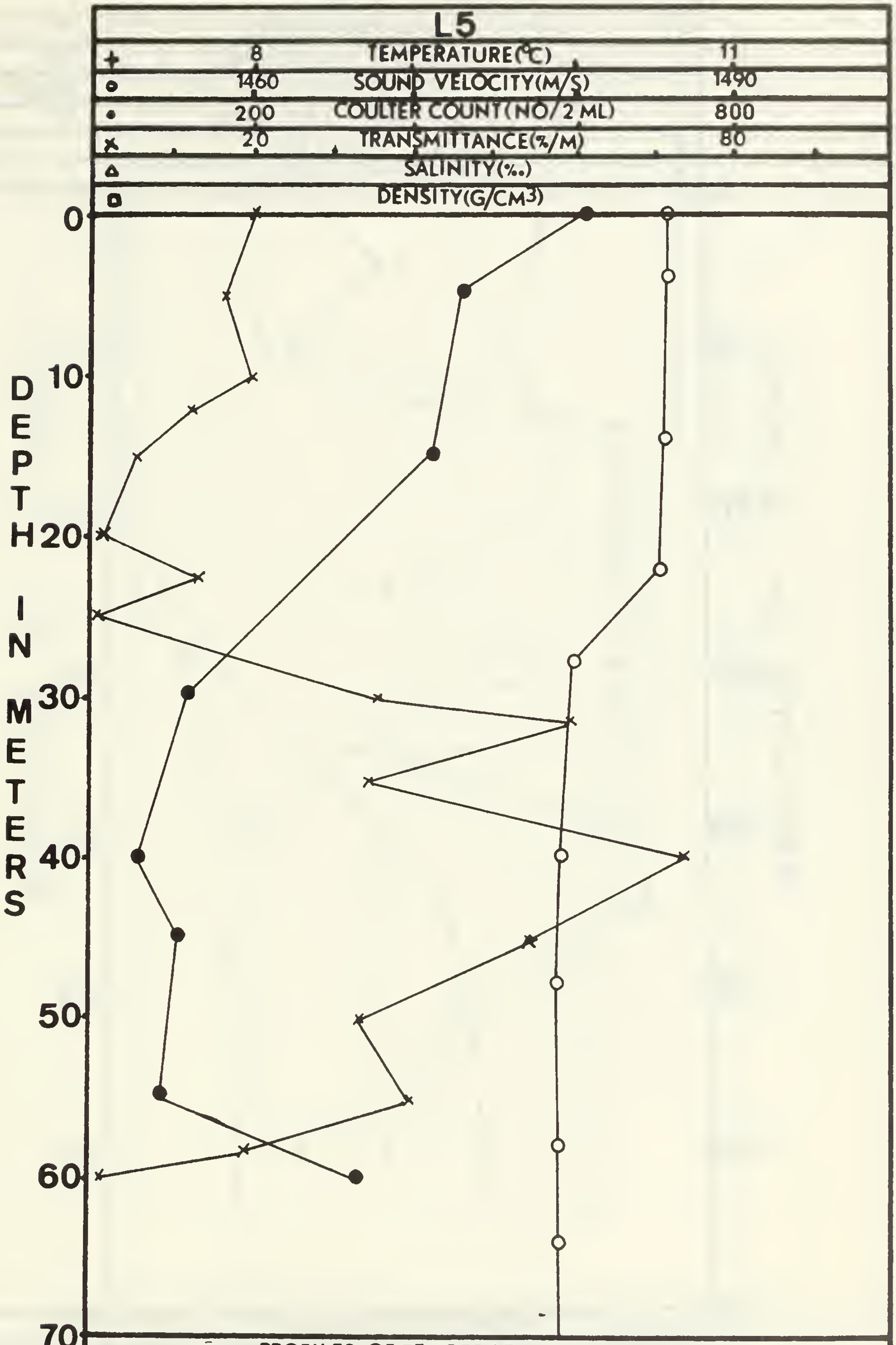

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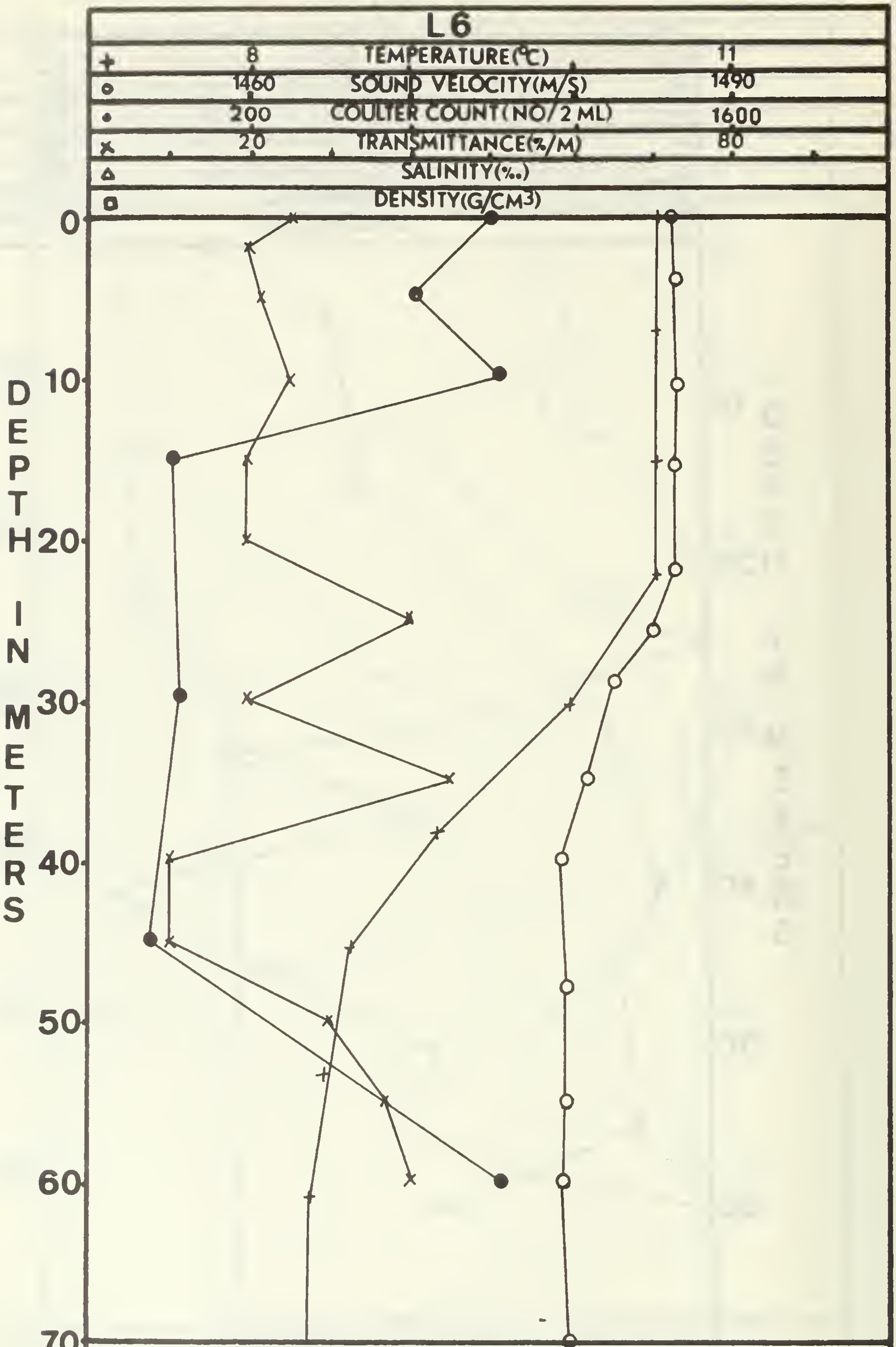

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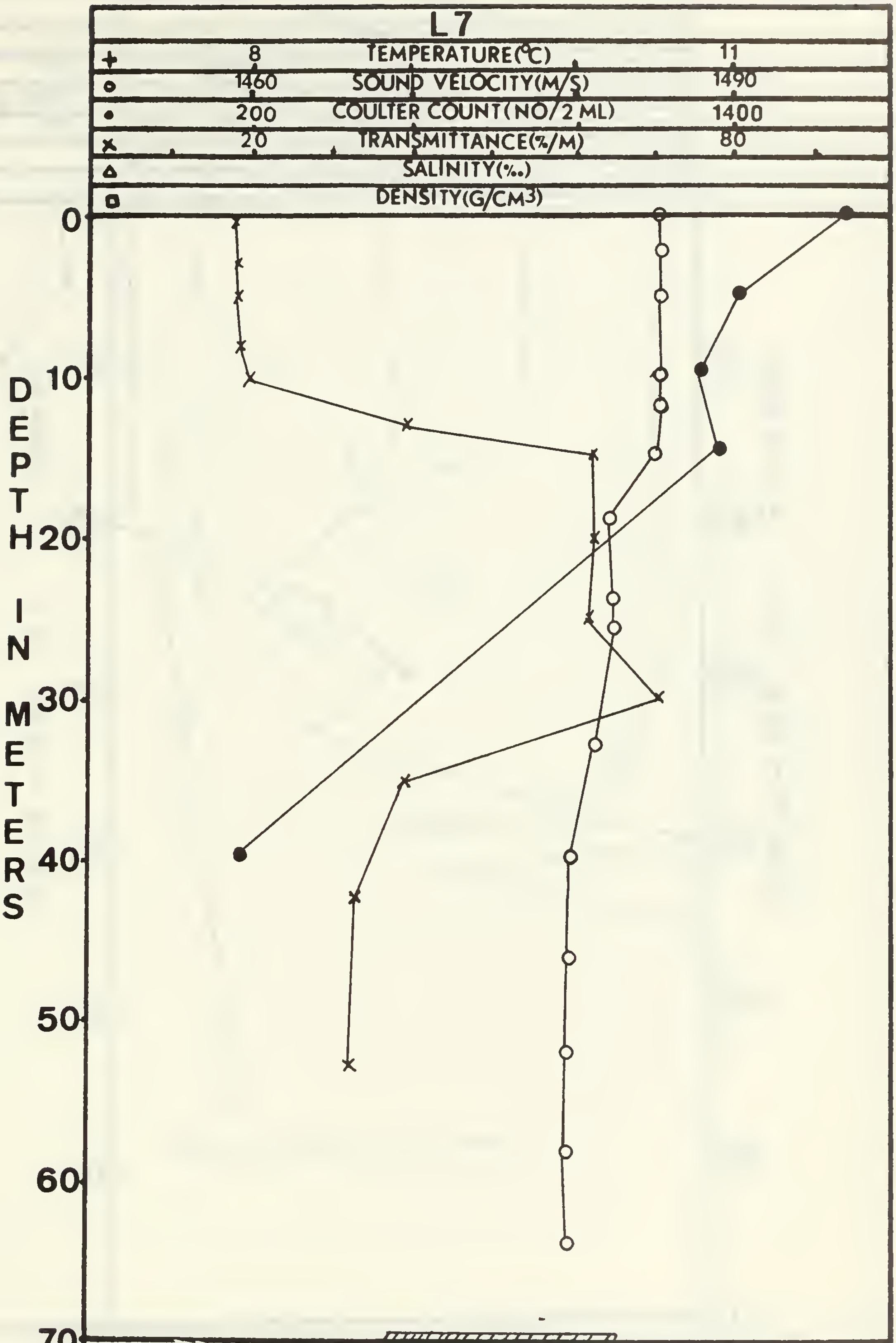

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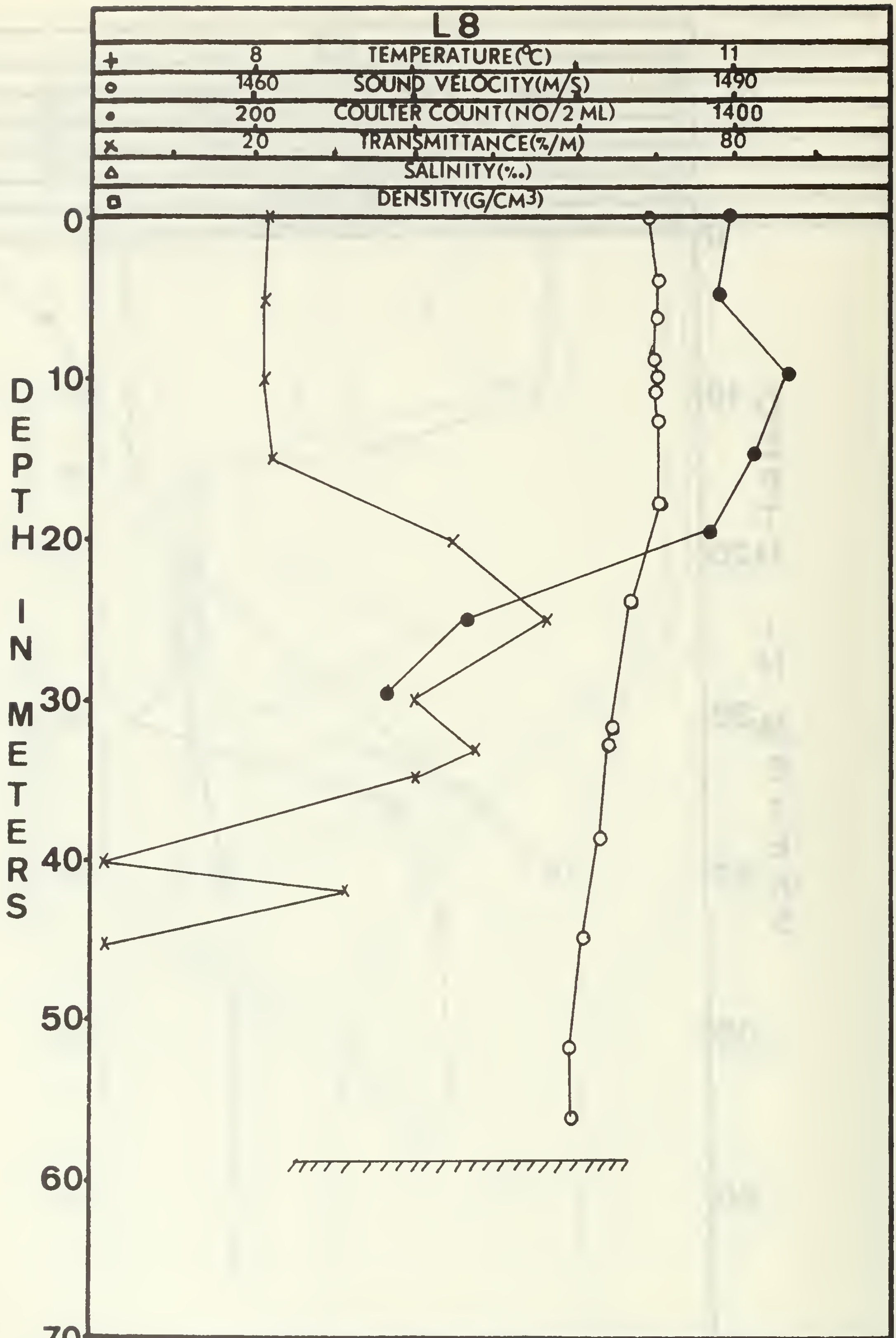

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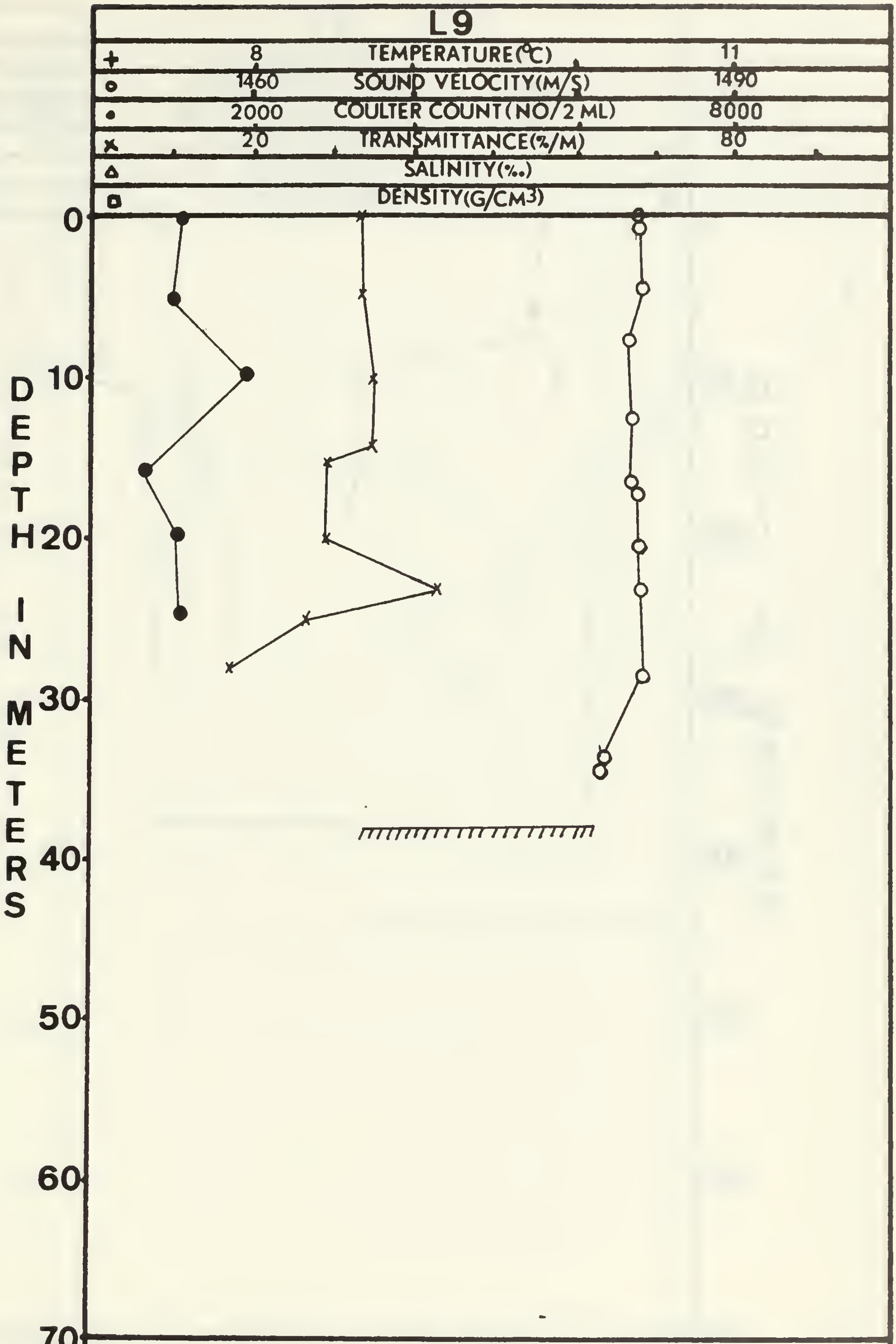

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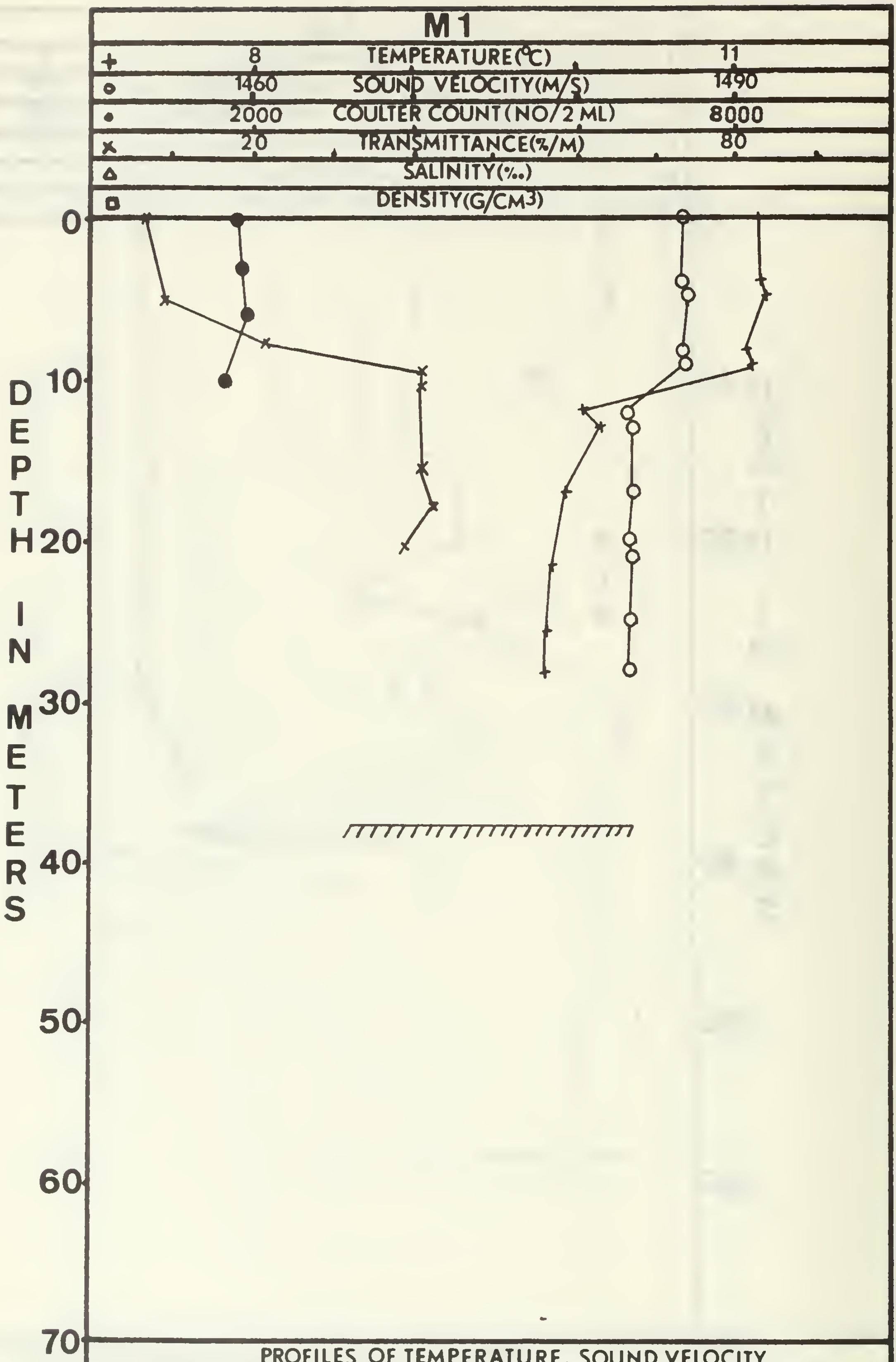

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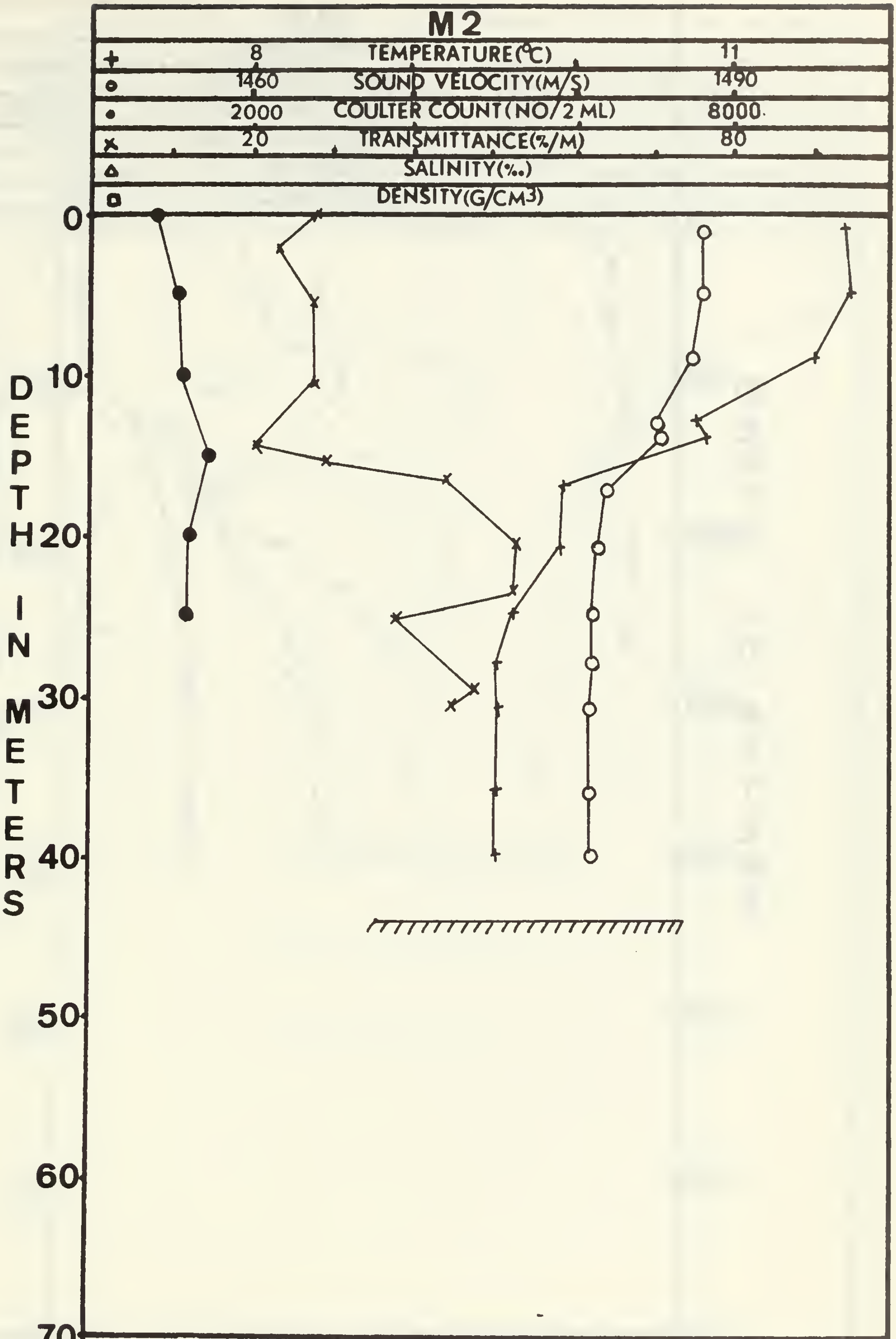

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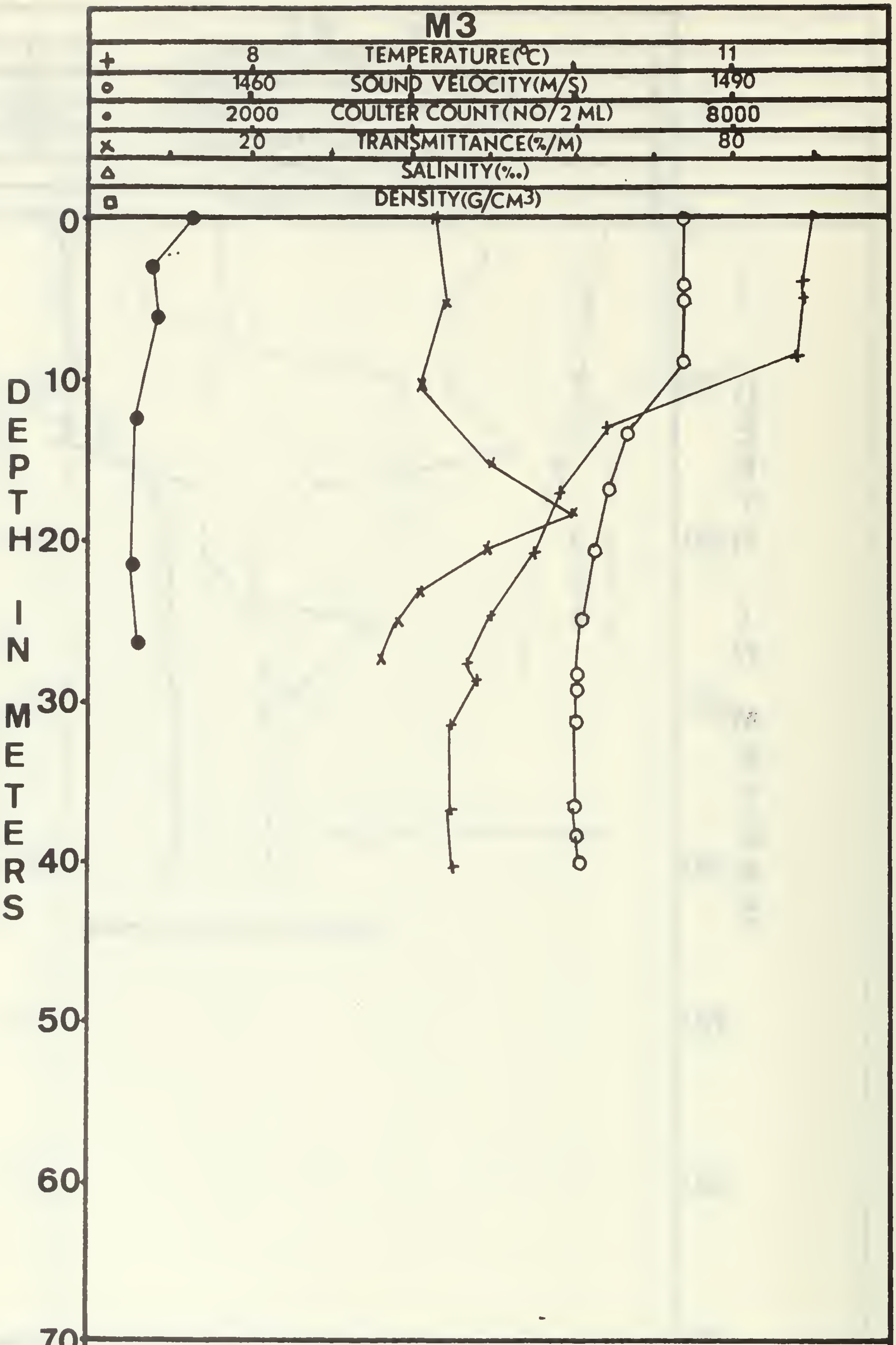

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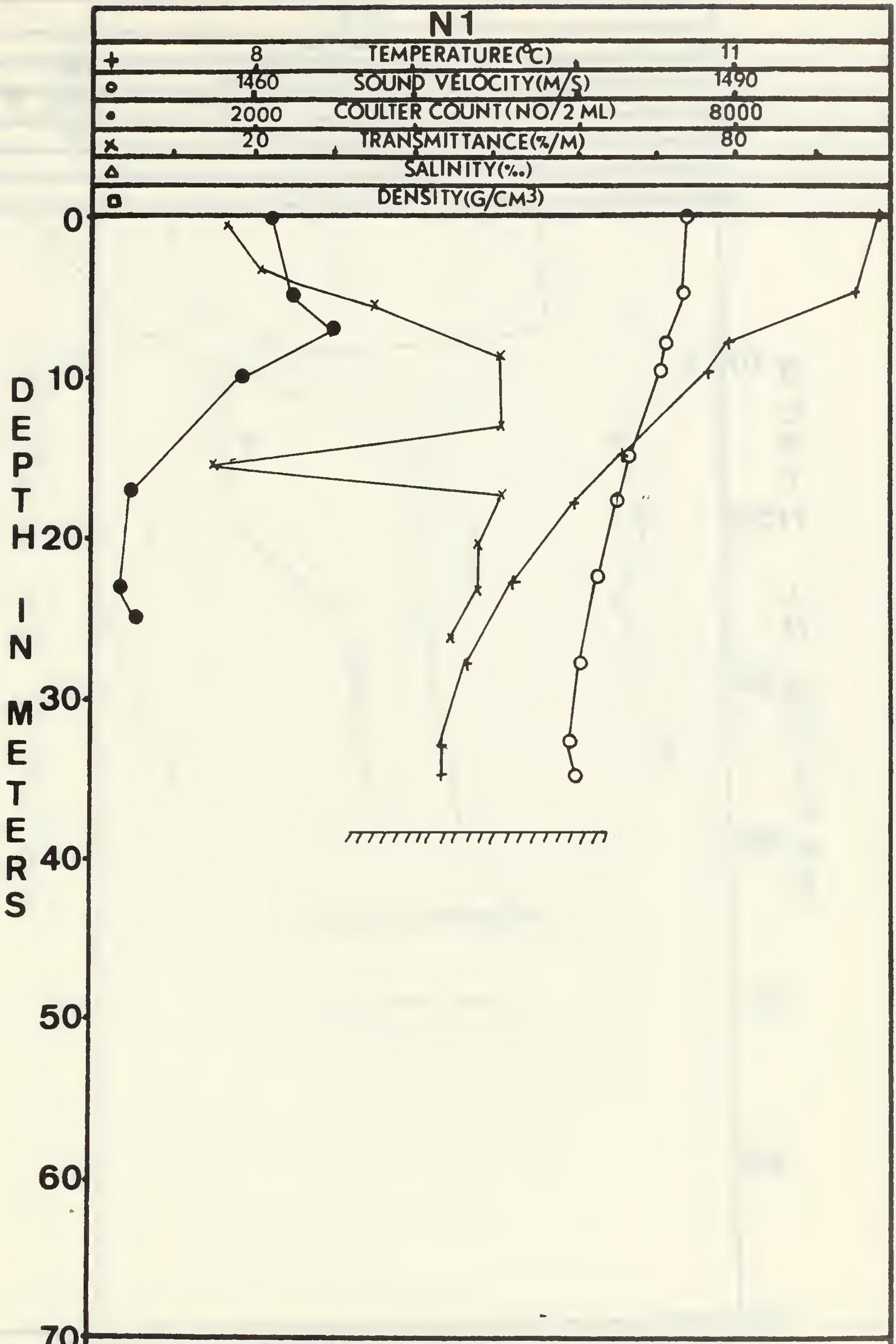

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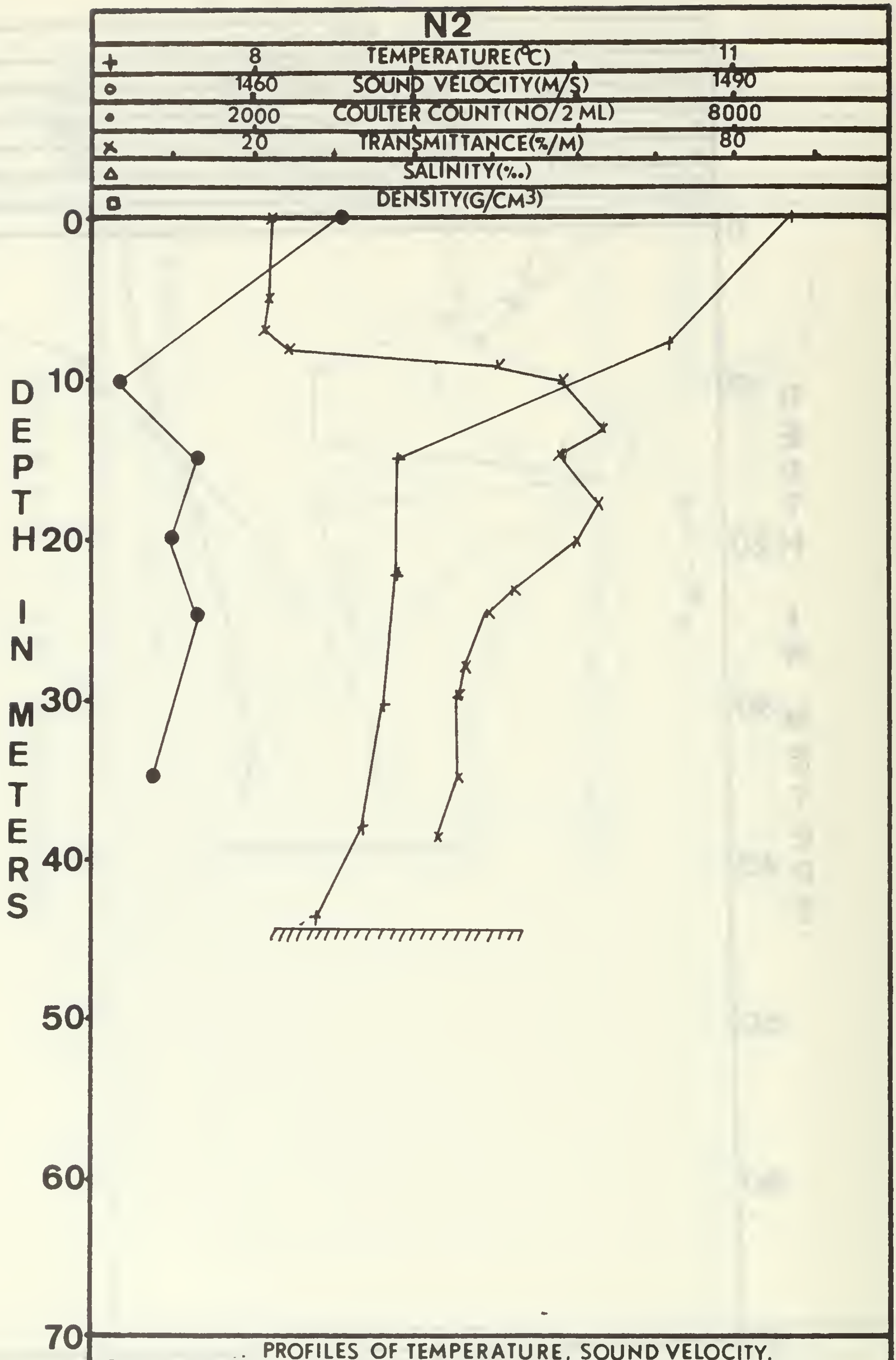

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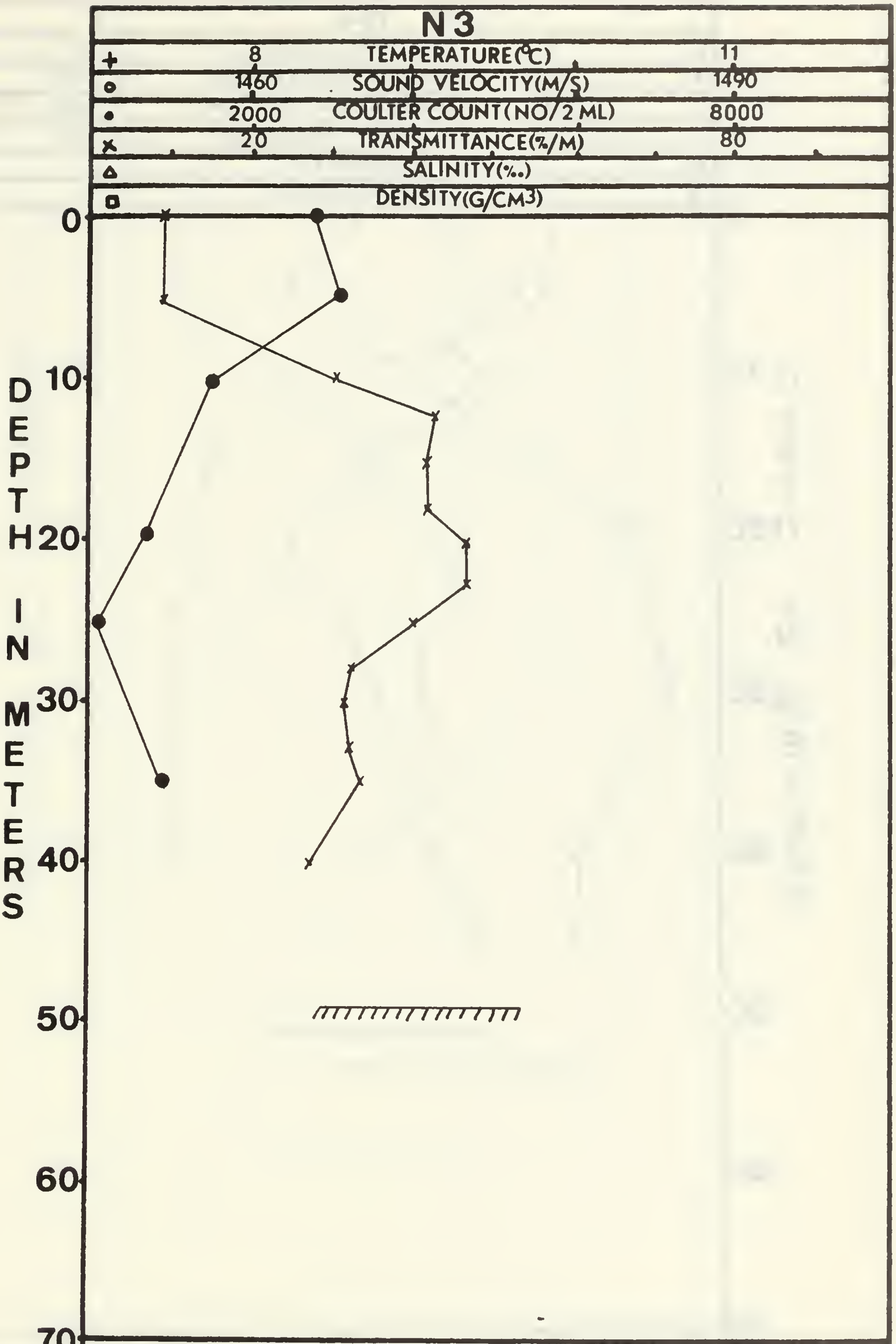

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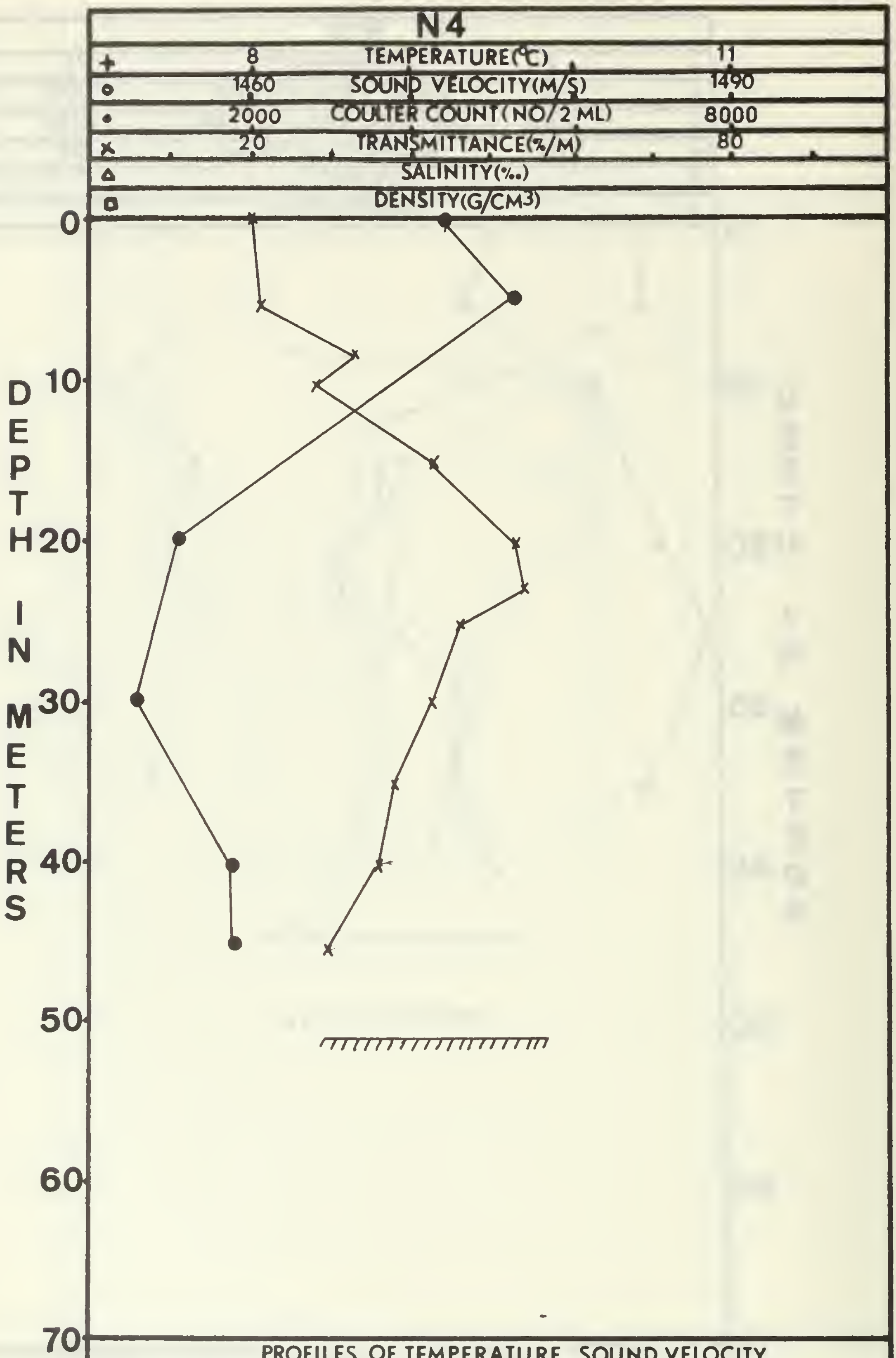

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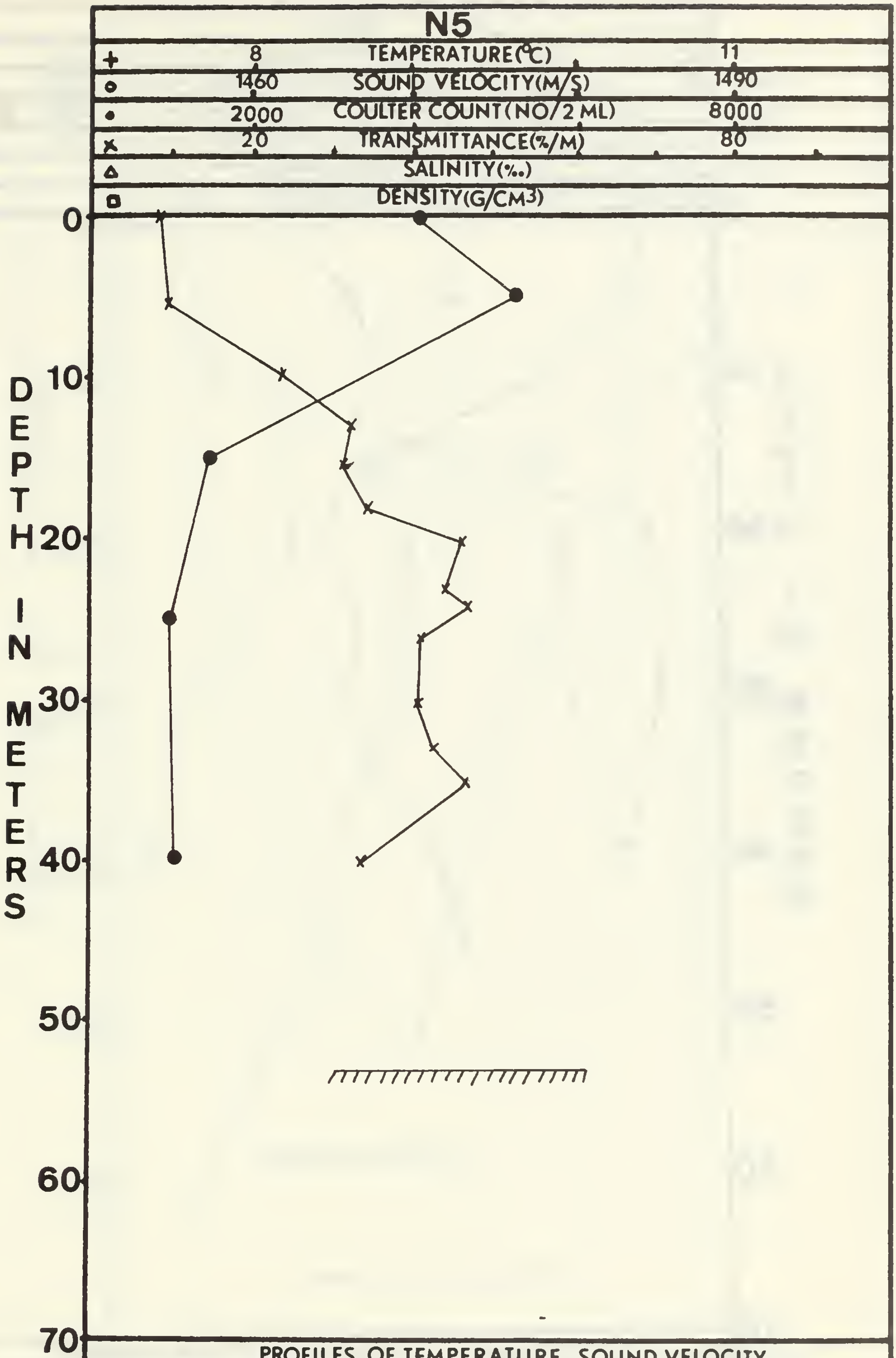

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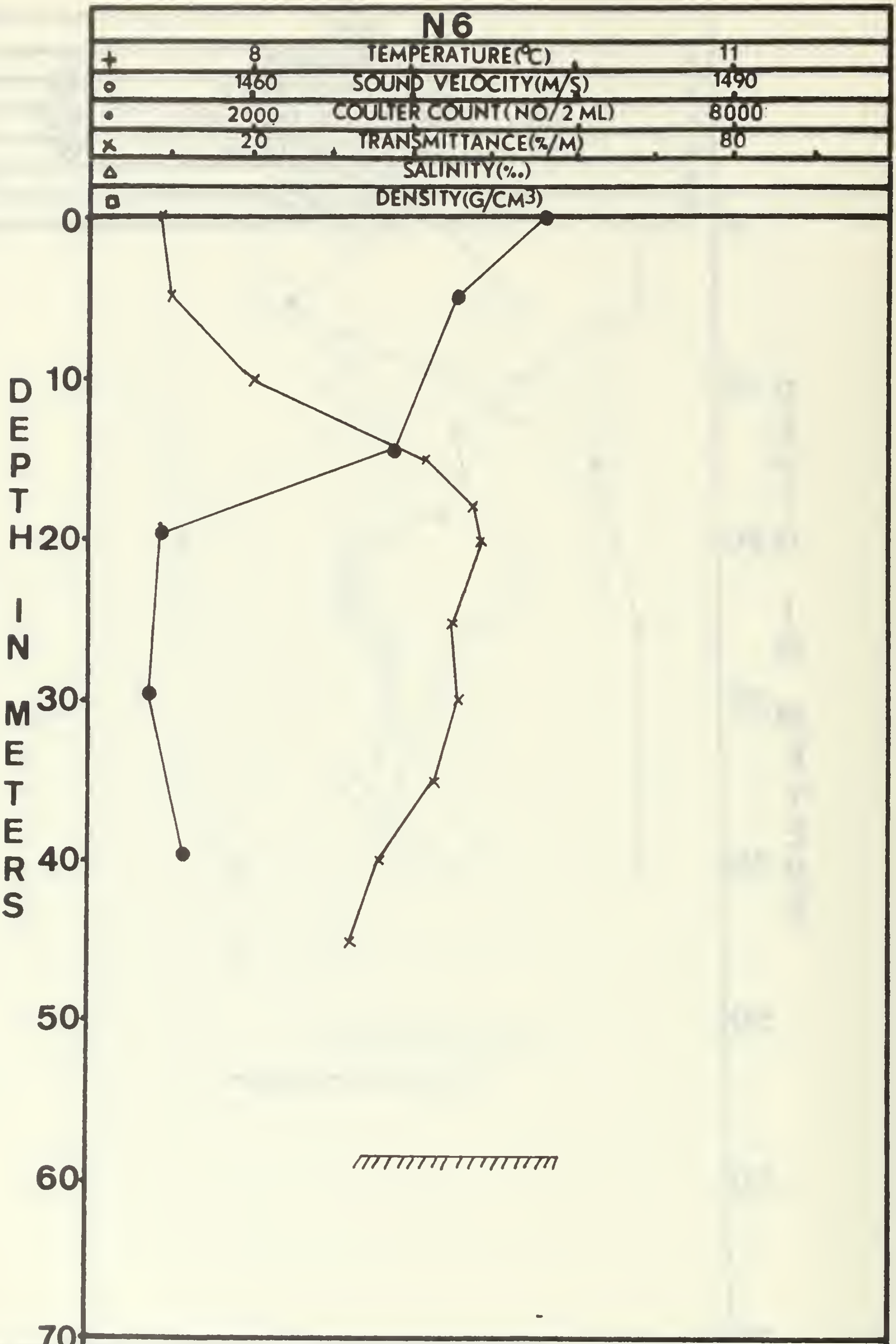

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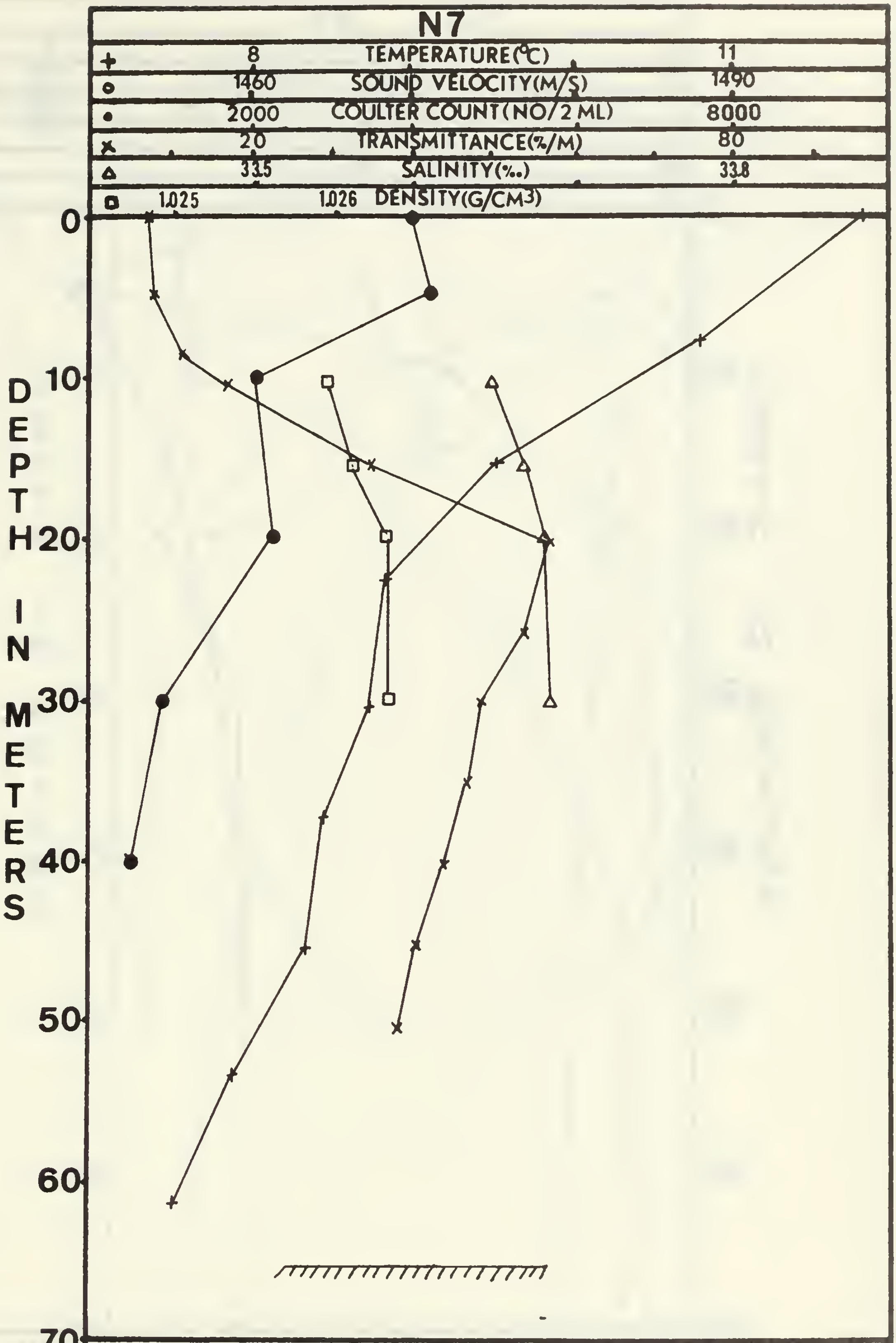

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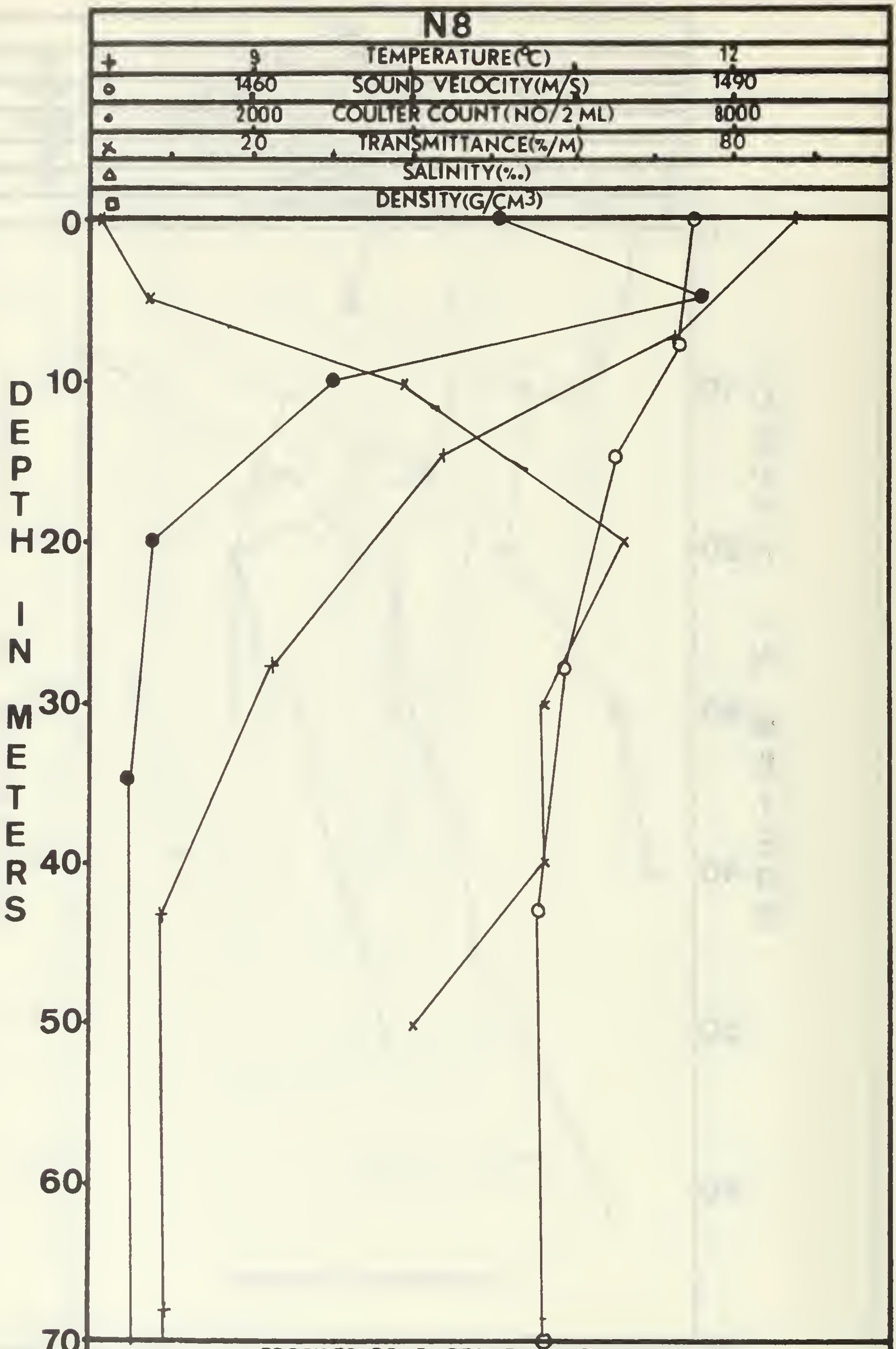

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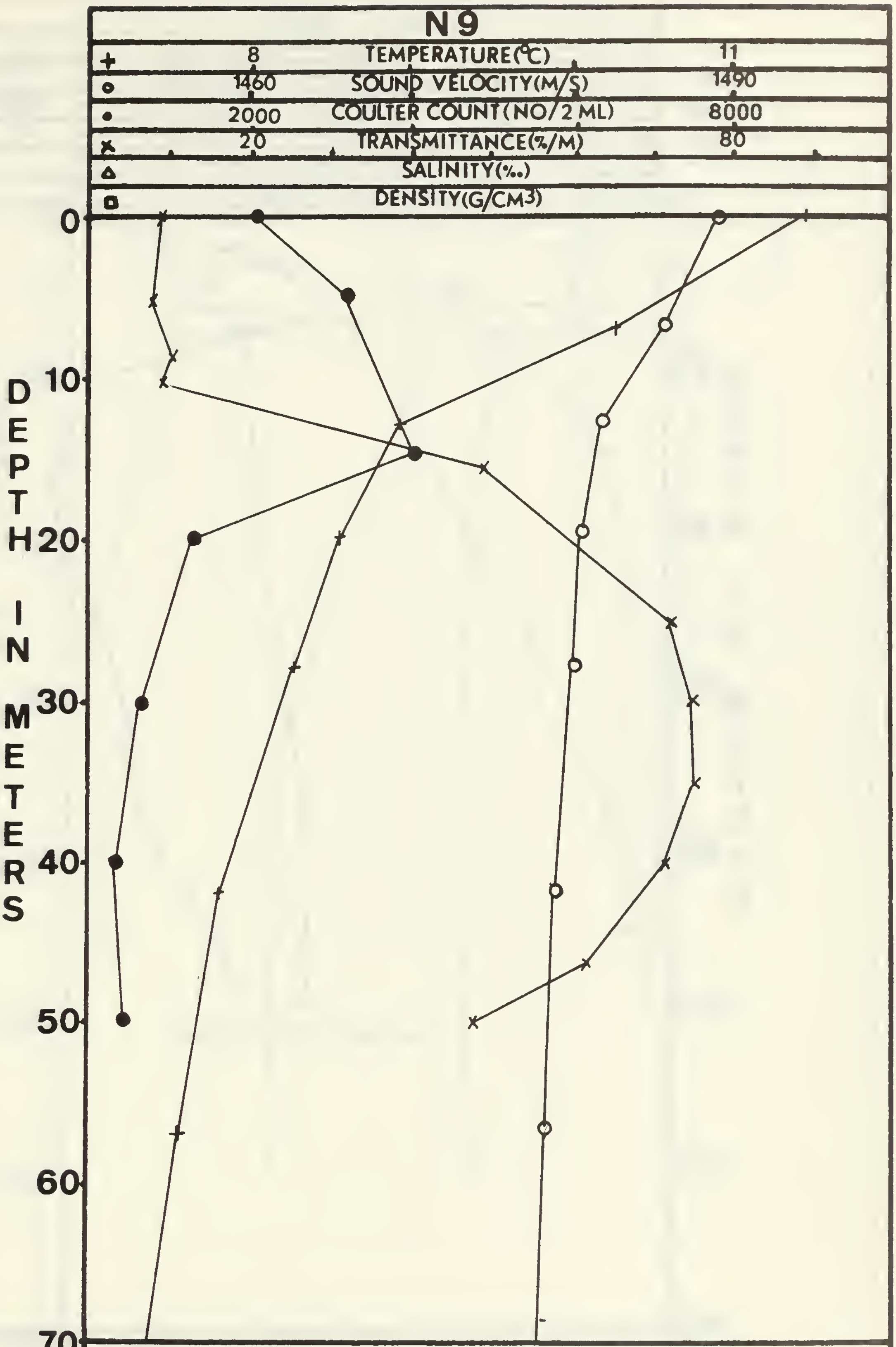
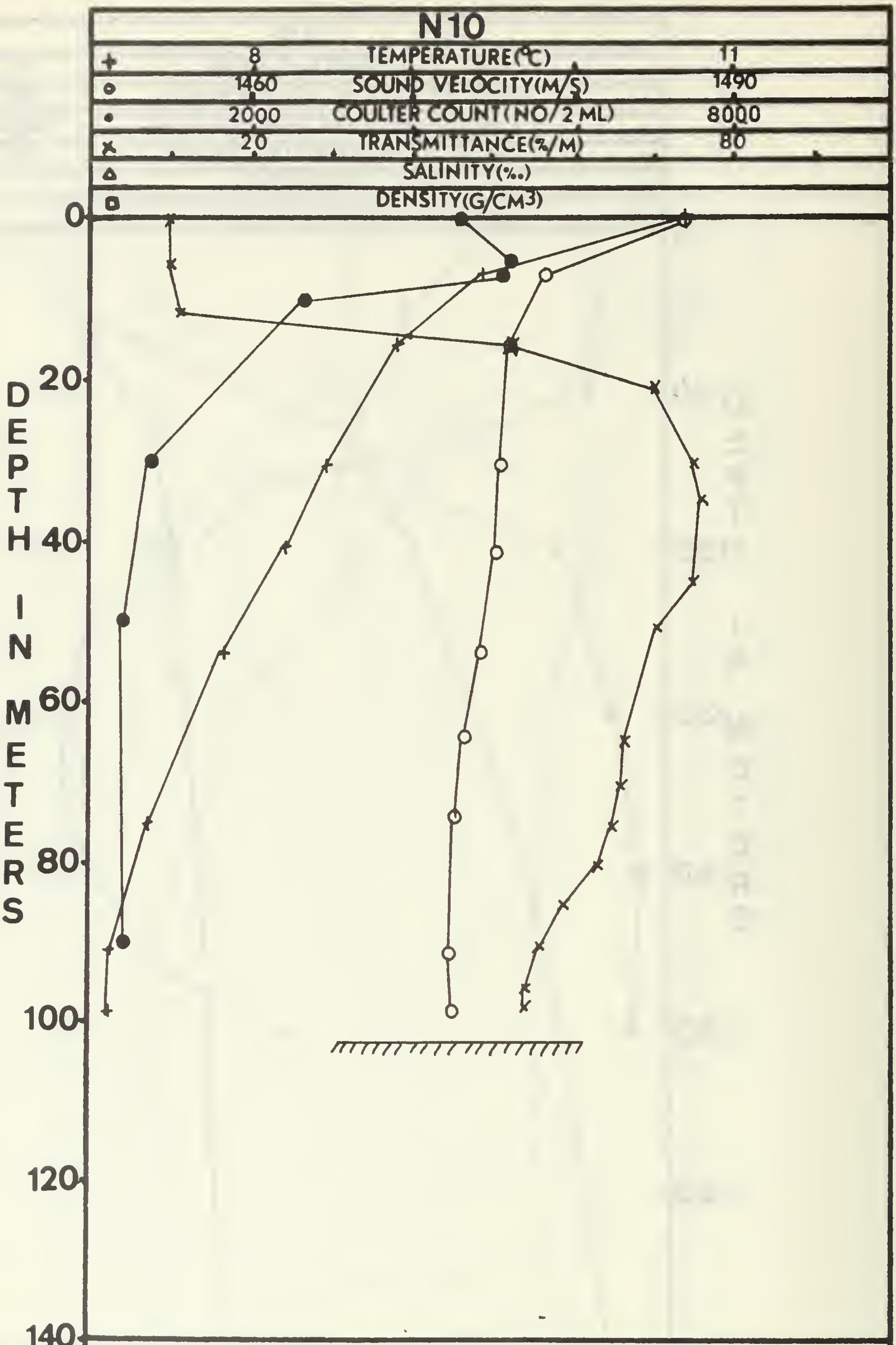
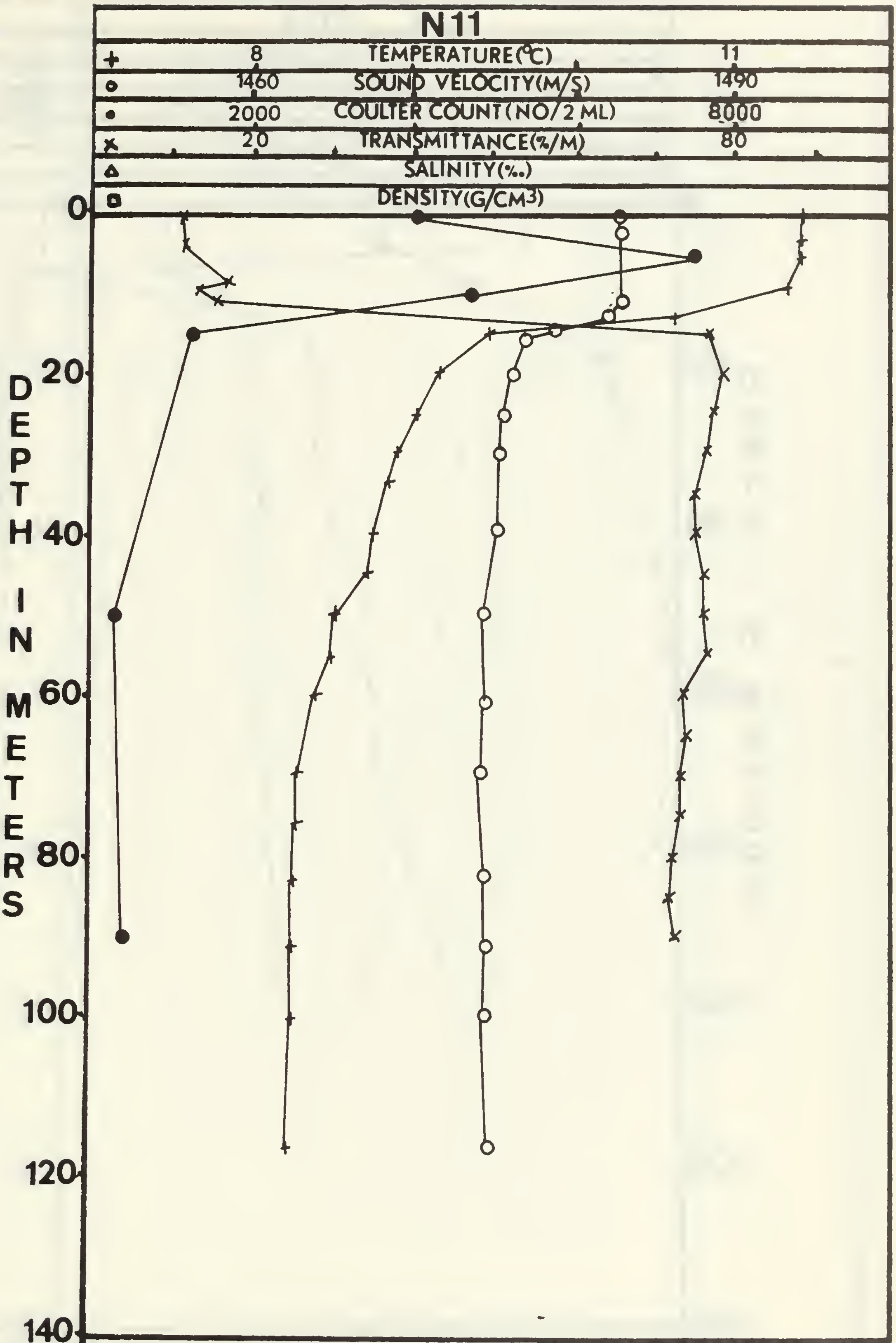


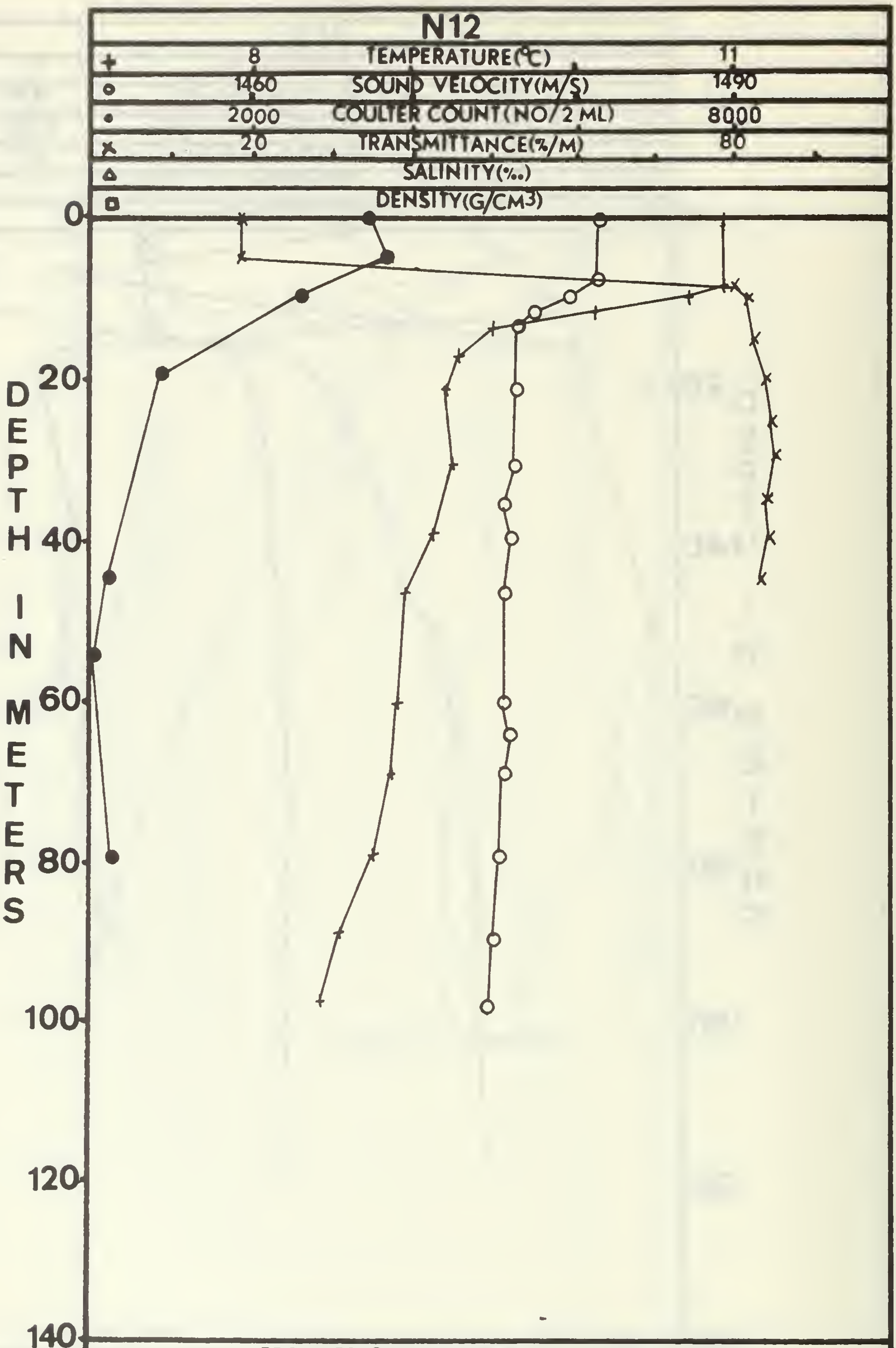
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



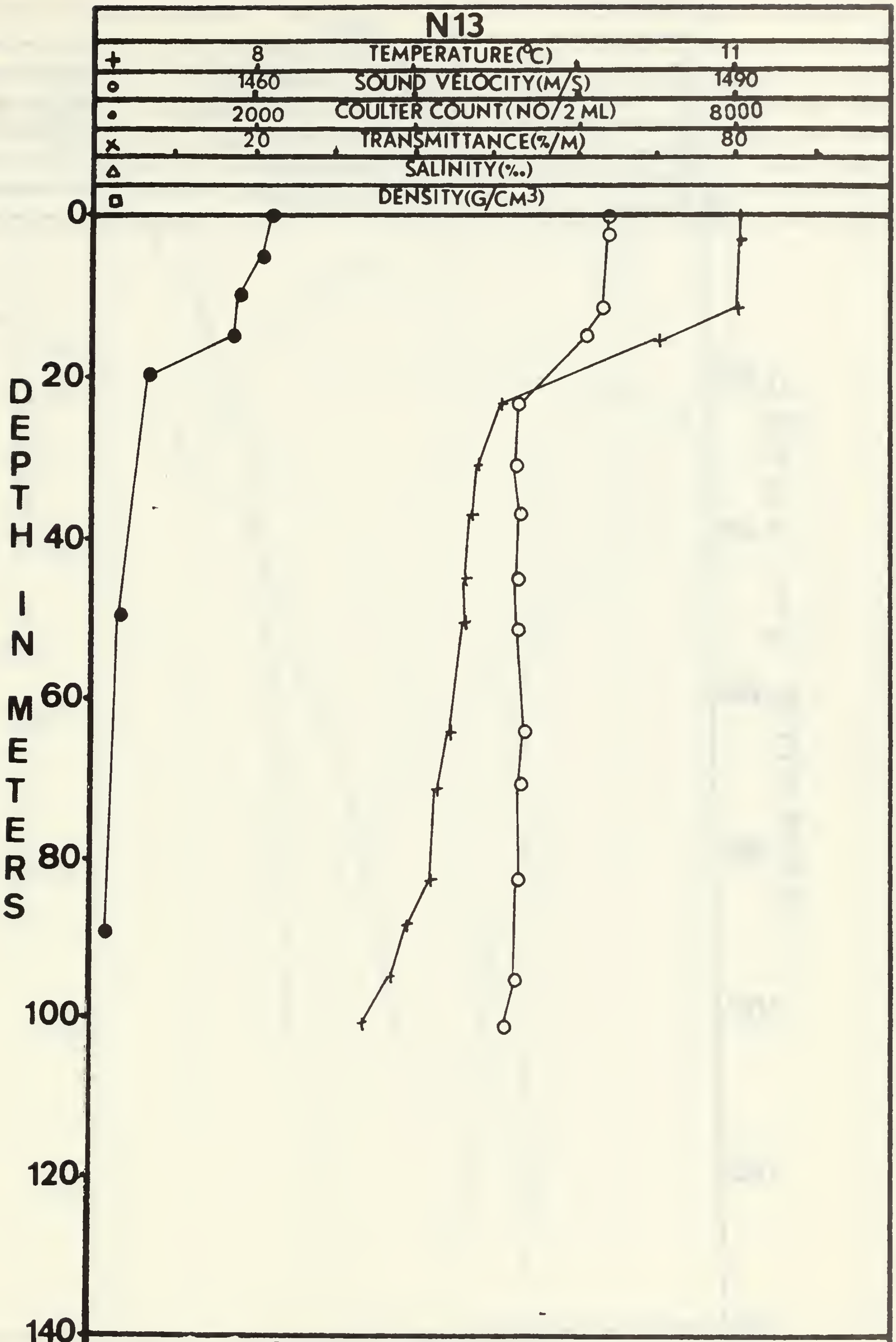
PROFILES OF TEMPERATURE, SOUND VELOCITY,
TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



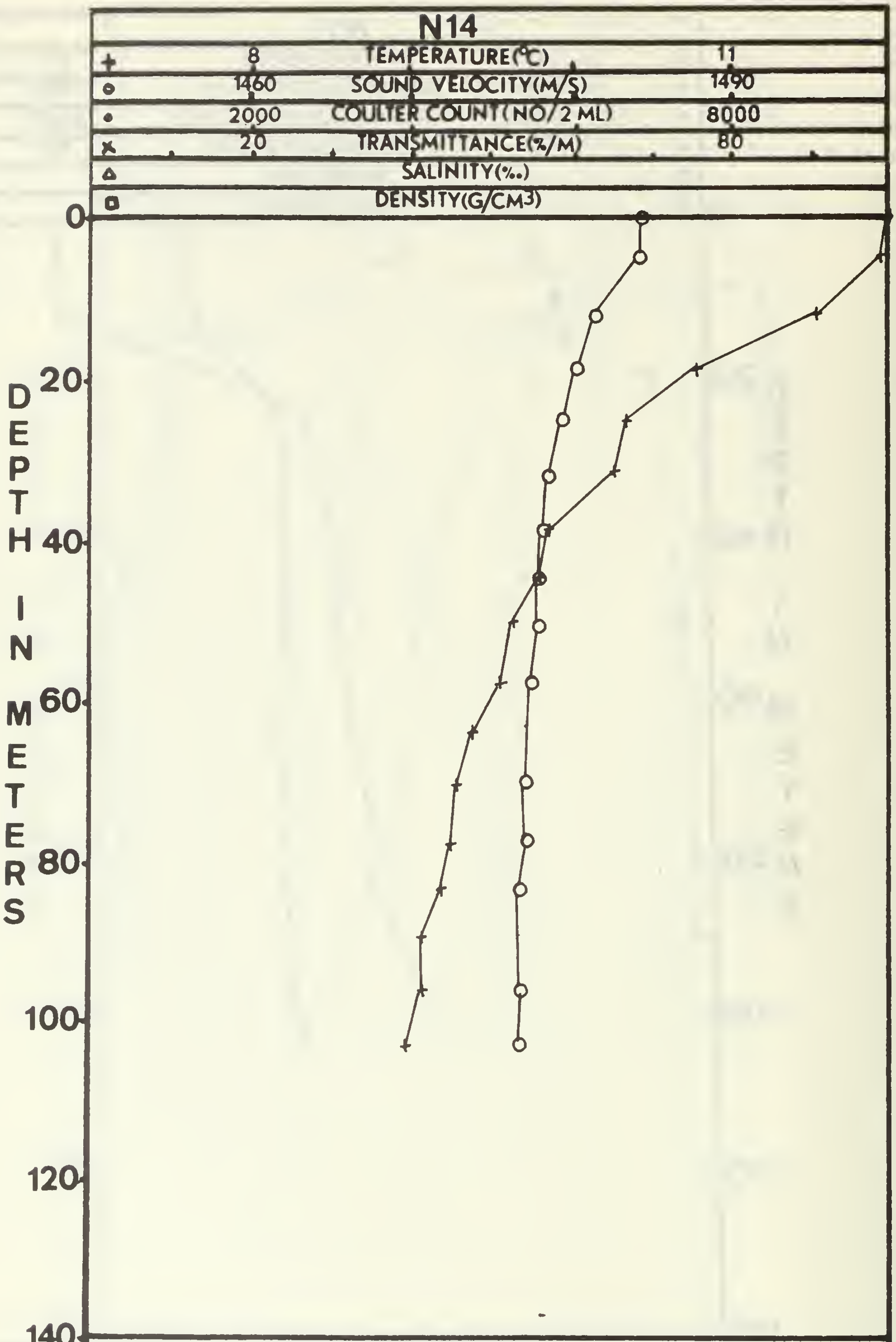
PROFILES OF TEMPERATURE, SOUND VELOCITY,
TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



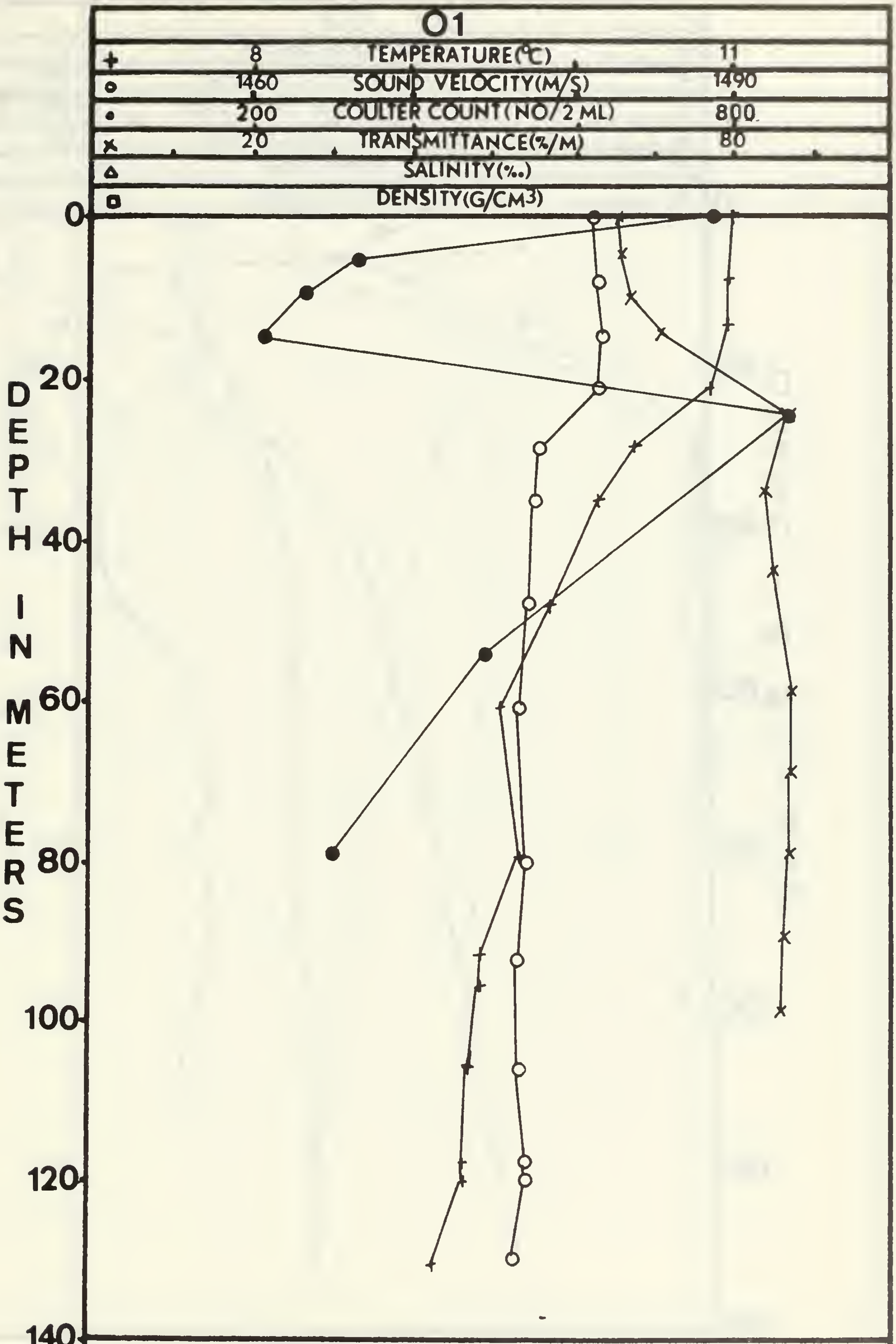
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



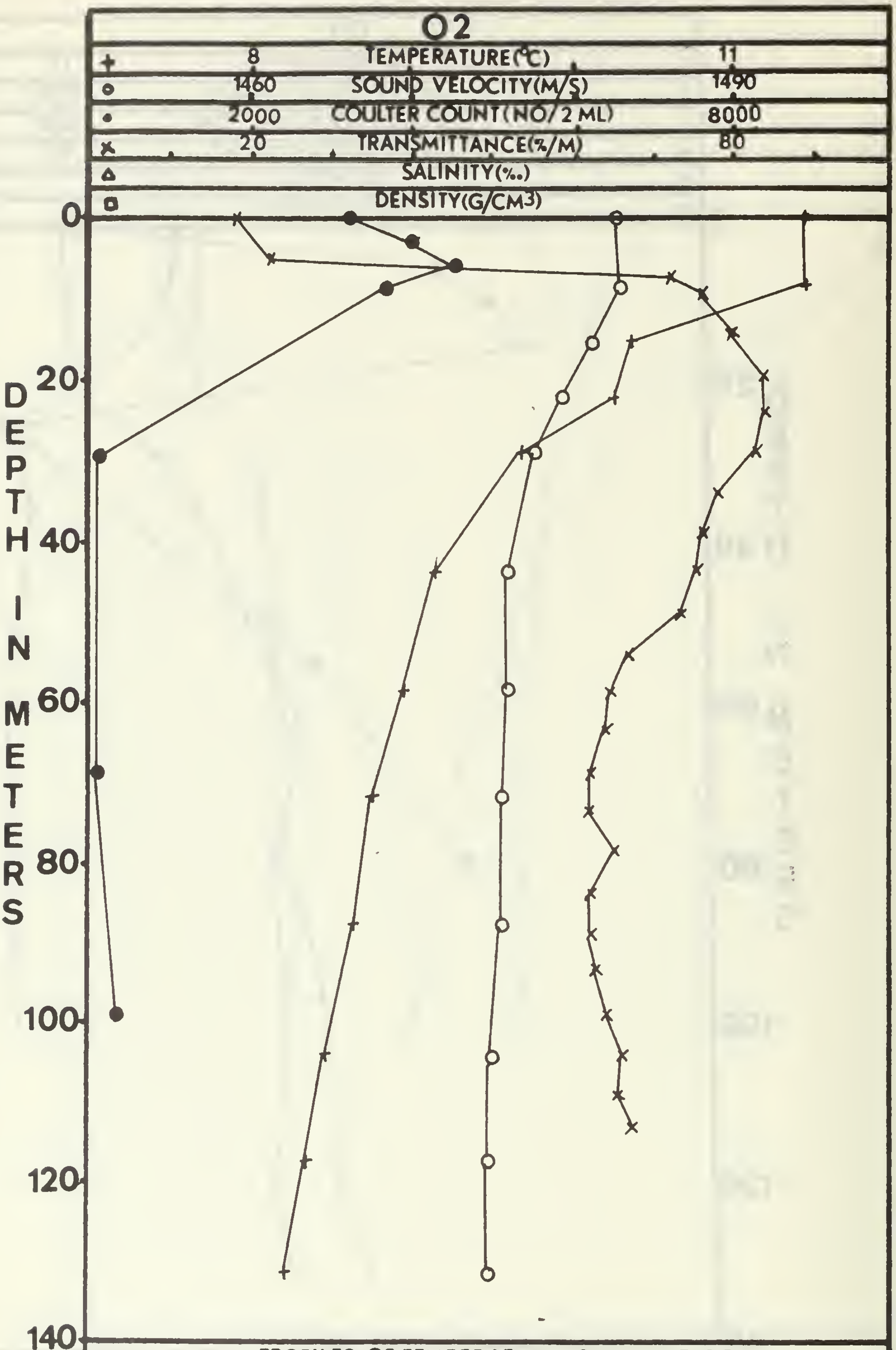
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



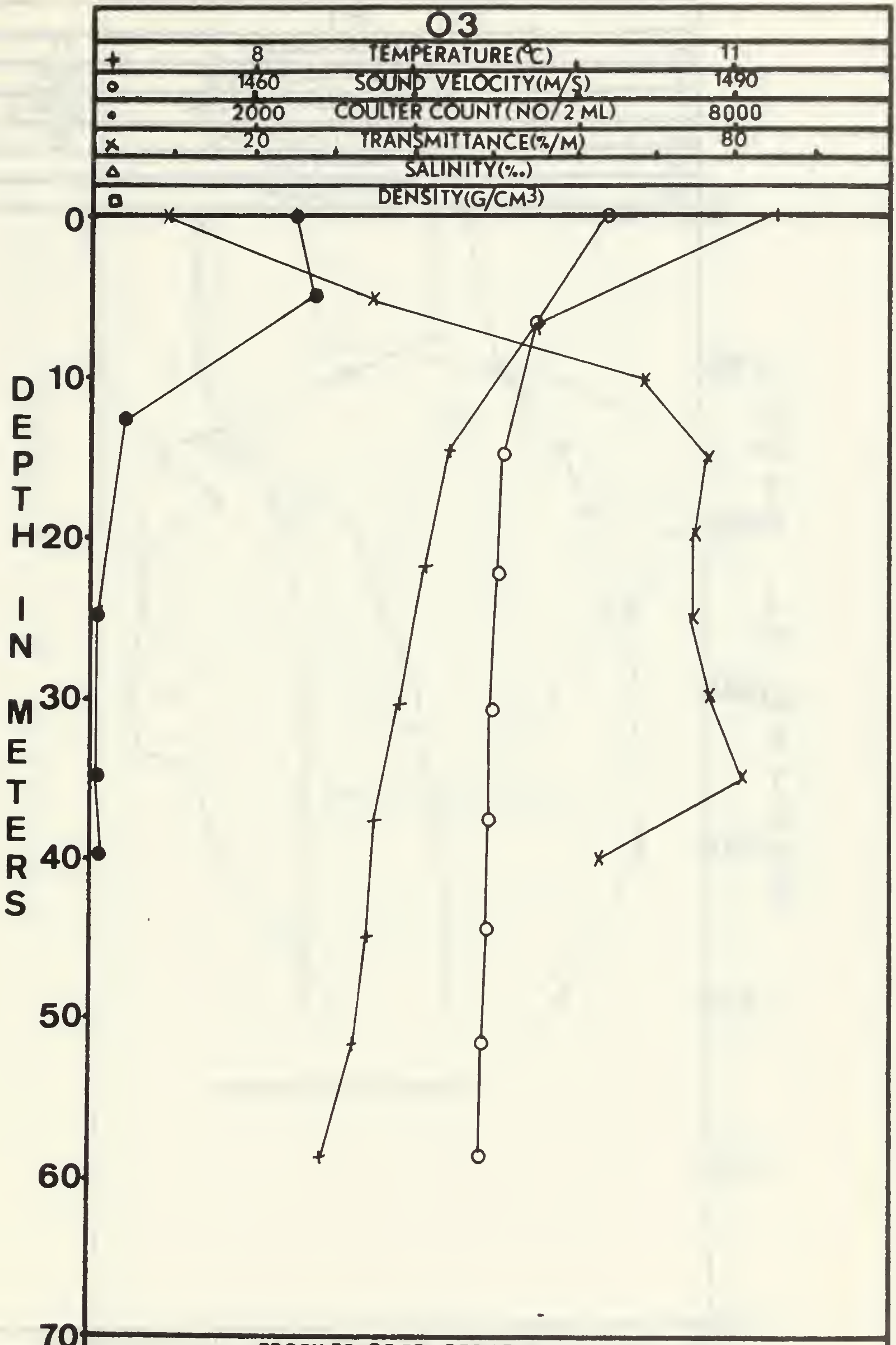
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



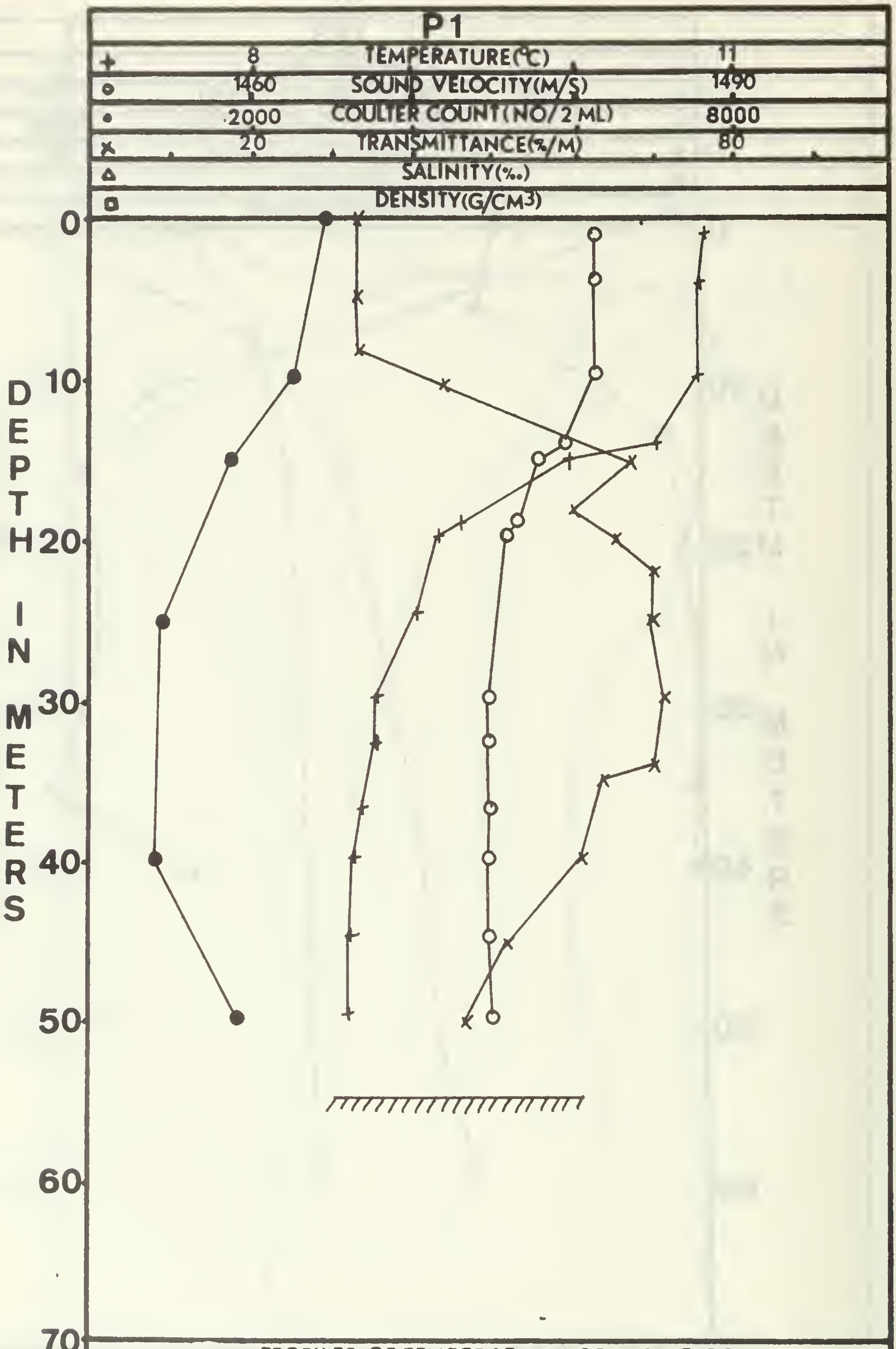
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



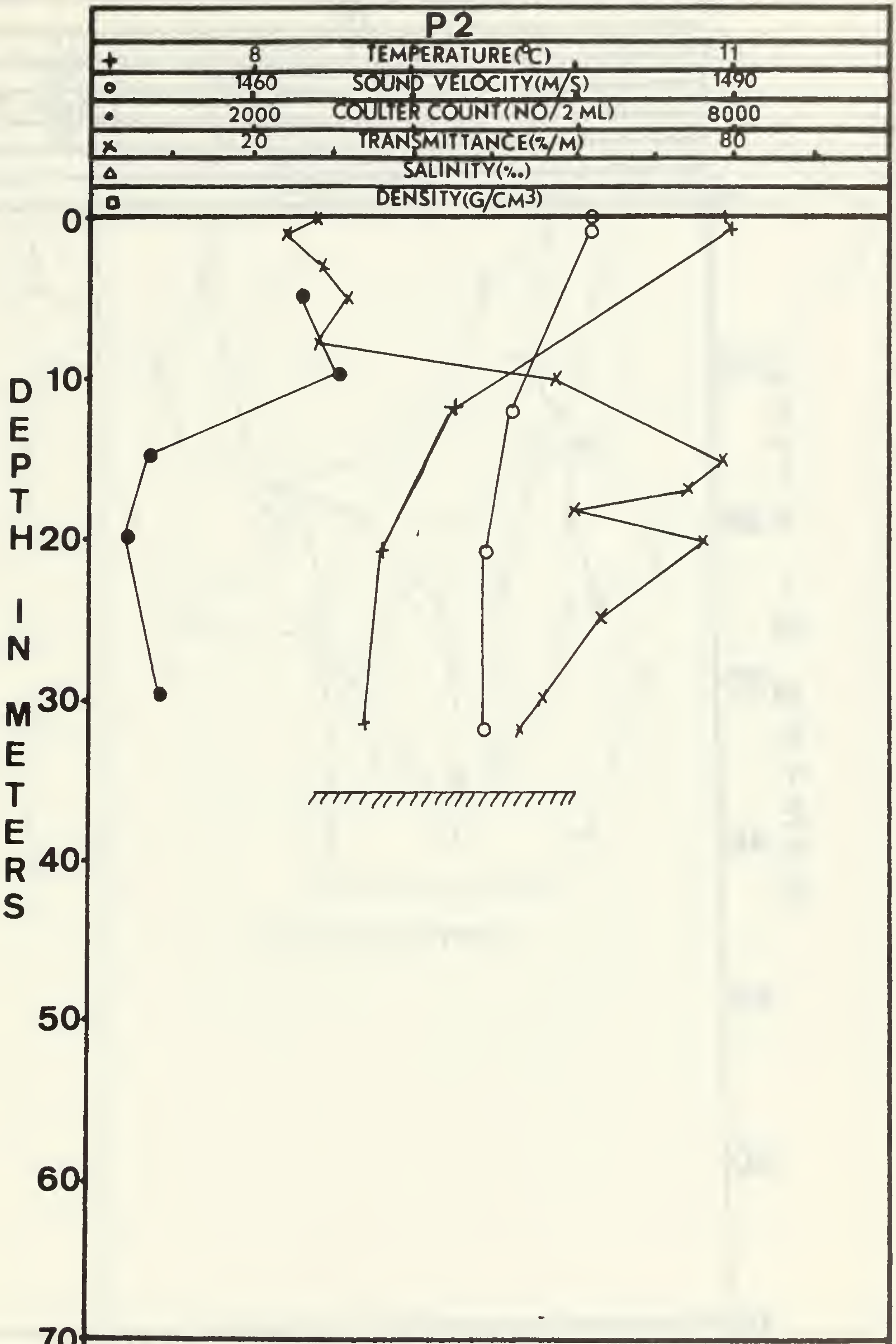
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



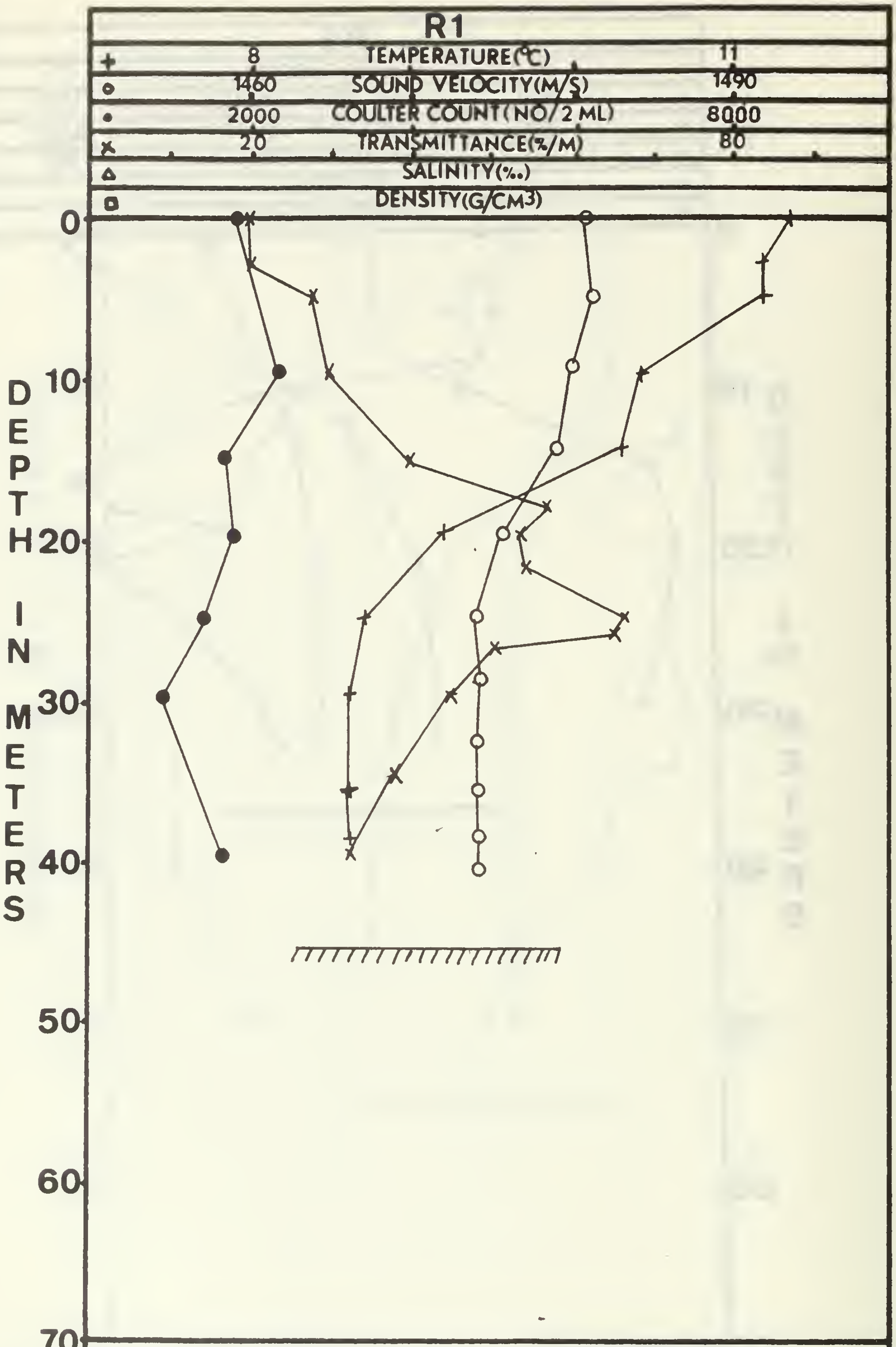
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



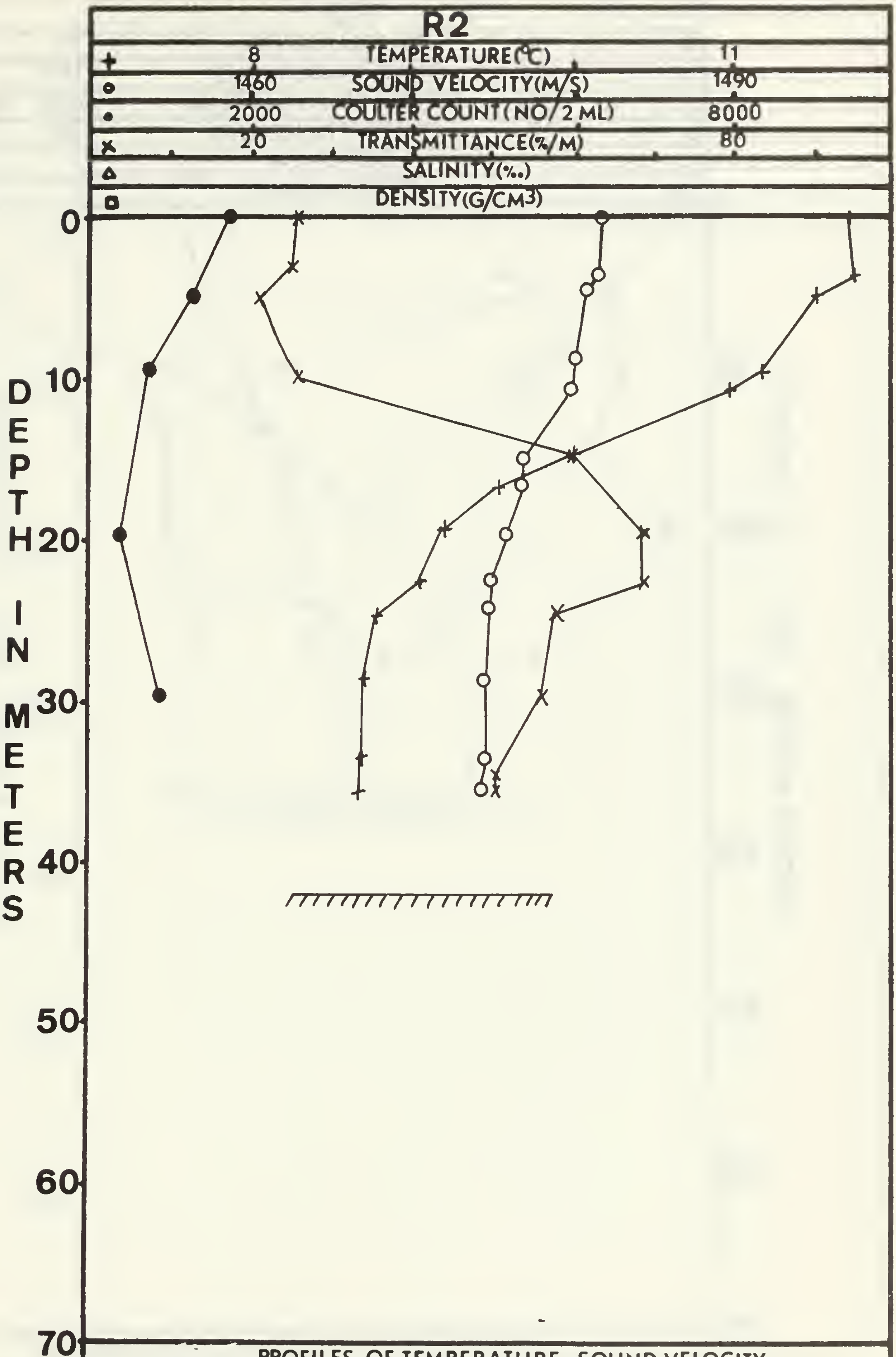
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



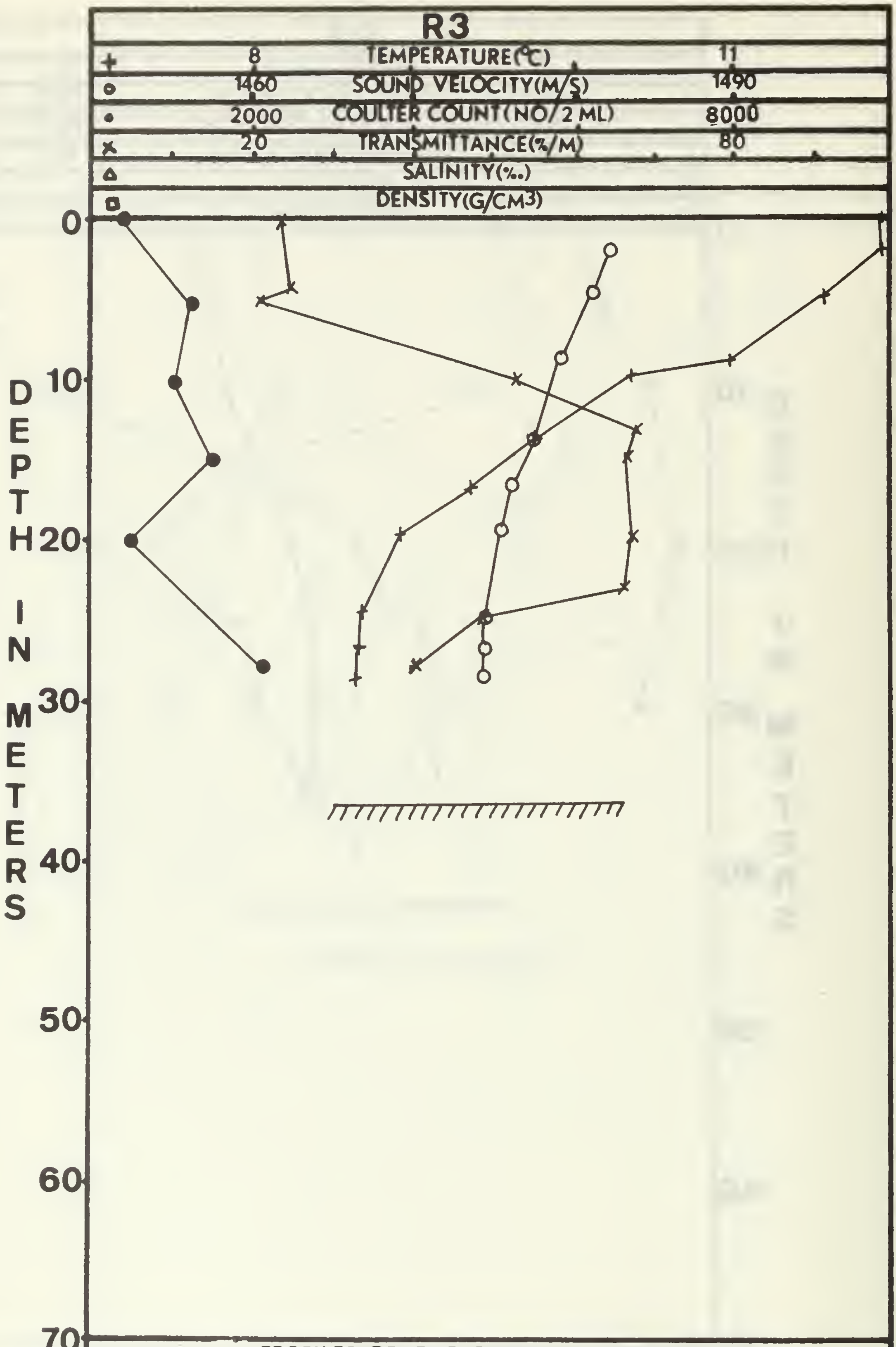
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



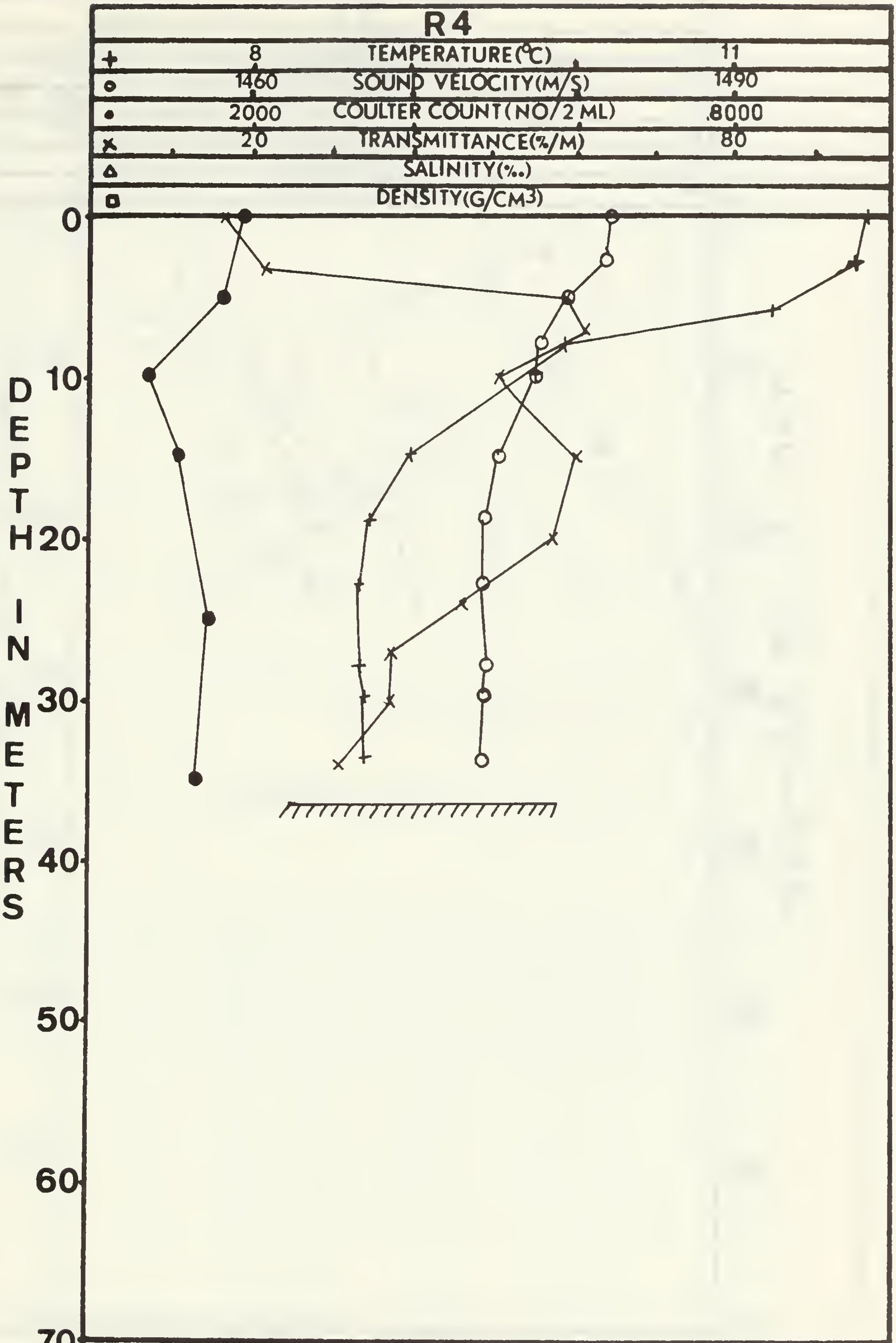
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



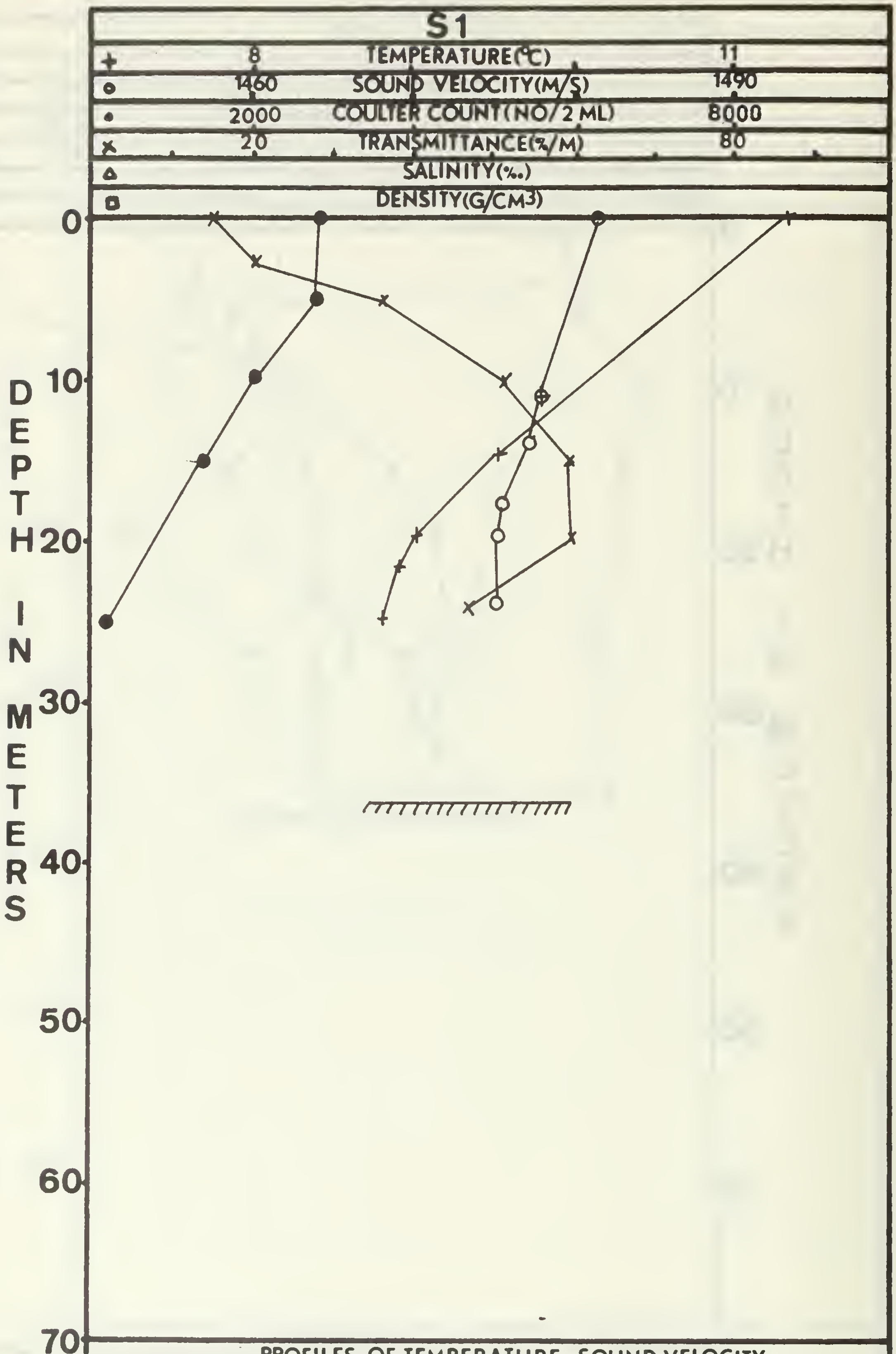
PROFILES OF TEMPERATURE, SOUND VELOCITY,
TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



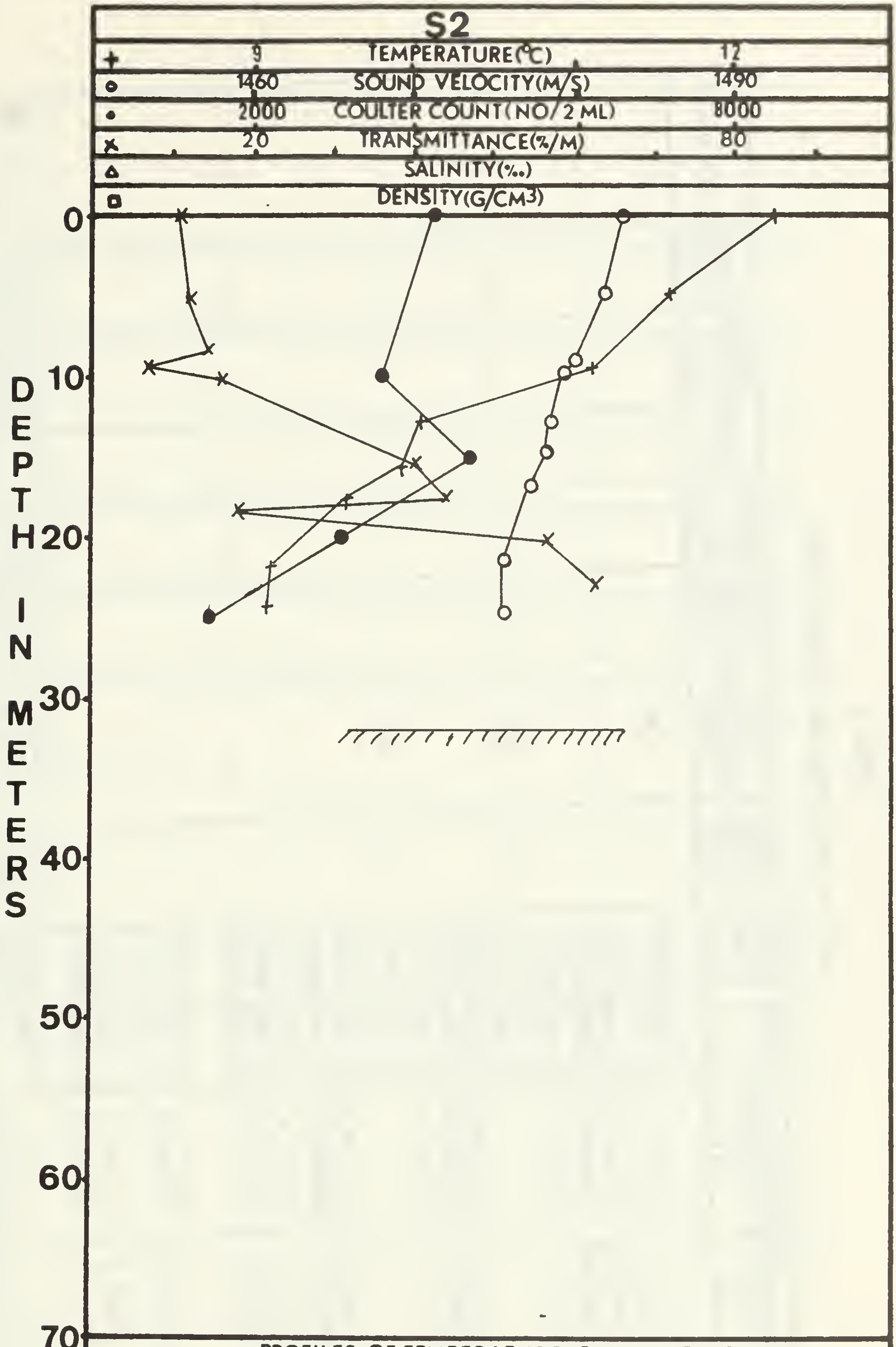
PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY



PROFILES OF TEMPERATURE, SOUND VELOCITY, TOTAL COULTER COUNT, BEAM TRANSMITTANCE, SALINITY, AND DENSITY

TABLE 1

STATION POSITIONS AND WEATHER DATA

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
			10 May	2000	6	230						
D-1	36-55.1	122-00.0	10 May	2243								
	36-55.2	122-00.0	10 May	2310								
			11 May	0000	6	235						
D-2	36-53.6	121-58.8	11 May	0039								
	36-53.6	121-58.8	11 May	0110								
			11 May	0400	6	240						
D-3	36-52.5	121-58.8	11 May	0610								
	36-52.5	121-58.8	11 May	0620								
D-4	36-51.6	121-58.6	11 May	0635								
	36-51.6	121-58.6	11 May	0650								
D-5	36-50.2	121-58.8	11 May	0708								
	36-50.2	121-58.8	11 May	0717								
D-6(1)	36-49.6	121-58.8	11 May	0733								
	36-49.6	121-58.8	11 May	0750								
			11 May	0800	3	290						
			11 May	1200	6	290						

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
			11 May	1600	7	250						
			11 May	2000	5	270						
			12 May	0000	3	240						
			12 May	0200	10	260	52	48	St	10	1000	1
D-6(2)	36-49.2	121-59.3	12 May	0326								
	36-49.1	121-58.9	12 May	0445								
			12 May	0445								
D-7	36-48.0	121-59.0	12 May	0510								
	36-47.8	121-57.8	12 May	0559								
			12 May	0600	10	315	52	48	St	10	1000	1
D-8	36-46.7	121-59.0	12 May	0632								
	36-46.7	121-58.4	12 May	0830								
D-9	36-45.6	121-59.8	12 May	0837								
	36-45.8	121-59.2	12 May	0940								
			12 May	1000	8	265	53	48	St	10	800	1
D-10	36-43.8	121-59.4	12 May	1030								
	36-43.7	121-59.3	12 May	1130								

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
D-11	36-42.5	121-59.2	12 May	1145								
	36-42.3	121-59.2	12 May	1230								
			12 May	1400	8	240	57	51	St	10	800	1
D-13	36-40.1	121-59.3	12 May	1509								
	36-40.1	121-59.5	12 May	1615								
D-14	36-39.5	121-58.9	12 May	1730								
	36-39.3	121-58.8	12 May	1815								
F-1	36-36.4	122-01.5	12 May	1855								
	36-36.3	122-01.3	12 May	1930								
			12 May	2000	3	215	55	50	Sc	10	1000	1
F-2	36-33.5	122-04.3	12 May	2028								
	33-33.5	122-04.3	12 May	2130								
F-3	36-30.0	122-06.4	12 May	2220								
	36-29.5	122-06.6	12 May	2330								
			13 May	0000	CALM	---	52	46	Sc	10	1000	0
			13 May	0200	4	2000	53	49	St	10	1000	1
G-1	36-35.2	122-11.1	13 May	0209								
	36-35.0	122-09.7	13 May	0350								

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
G-2	36-40.2	122-17.1	13 May	0445								
	36-40.1	122-16.8	13 May	0600								
			13 May	0600	4	315	52	48	Sc	10	1200	1
H-1	36-44.3	122-21.6	13 May	0650								
	36-44.5	122-21.1	13 May	0738								
H-2	36-48.2	122-17.8	13 May	0830								
	36-48.2	122-17.3	13 May	0950								
			13 May	1000	5	185	58	50	St	10	1200	1
H-3	36-53.2	122-13.5	13 May	1023								
	36-53.6	122-13.6	13 May	1115								
H-4	36-53.8	122-12.0	13 May	1140								
	36-54.0	122-12.0	13 May	1347								
			13 May	1400	5	240	66	57	Sc	10	2000	1
H-5	36-55.0	122-11.0	13 May	1422								
	36-55.2	122-10.8	13 May	1520								
H-6	36-55.6	122-10.2	13 May	1555								
	36-56.0	122.09.5	13 May	1650								

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
H-7	36-56.6	122-09.8	13 May	1747								
	36-56.8	122-09.6	13 May	1830								
H-8	36-57.3	122-09.0	13 May	1850								
	36-57.3	122-09.0	13 May	1920								
			13 May	2000	2	310	60	54	Sc	4	2000	1
I-1	36-59.1	122-12.4	13 May	2000								
	36-59.2	122-12.3	13 May	2036								
I-2	37-01.7	122-15.2	13 May	2111								
	37-01.7	122-15.3	13 May	2130								
J-1	37-03.8	122-18.0	13 May	2210								
	37-03.8	122-17.9	13 May	2305								
J-2	37-03.2	122-19.0	13 May	2325								
	37-03.2	122-19.0	13 May	2355								
			14 May	0000	5	040	50	46	Sc	3	2000	1
J-3	37-02.4	122-20.1	14 May	0047								
	37-02.4	122-20.1	14 May	0147								
			14 May	0200	CALM	---	50	47	Sc	8	1500	1
J-4	37-01.9	122-20.1	14 May	0157								

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
	37-01.8	122-20.8	14 May	0240								
J-5	37-01.3	122-22.1	14 May	0316								
	37-01.2	122-22.3	14 May	0350								
J-6	37-00.5	122-23.2	14 May	0450								
	37-01.0	122-24.2	14 May	0530								
			14 May	0600	CALM	---	54	50	Sc	10	1000	1
J-7	36-59.5	122-24.0	14 May	0640								
	36-59.7	122-24.5	14 May	0715								
J-8	36-59.1	122-24.8	14 May	0800								
	36-59.1	122-24.8	14 May	0845								
J-9	36-57.3	122-28.7	14 May	0915								
	36-57.6	122-28.7	14 May	1007								
			14 May	1000	CALM	---	58	52	Sc	10	1000	0
J-10	36-54.0	122-33.1	14 May	1045								
	36-54.2	122-33.3	14 May	1120								
K-1	37-00.5	122-42.0	14 May	1241								
	37-00.5	122-47.0	14 May	1430								

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (^{o}T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (^{o}F)	DRY (^{o}F)	TYPE	COVER (10th)	HEIGHT (FT)	
K-1-B	36-51.7	123-04.0	14 May	1854								
	36-48.5	122-58.5	15 May	0210								
			15 May	0200	15	330	53	49	Sc	10	1500	3
K-2	37-06.3	122-56.3	15 May	0518								
	37-04.7	122-55.6	15 May	0730								
			15 May	0600	14	340	53	50	St	10	2000	3
LE	37-09.5	122-41.5	15 May	0900								
			15 May	1000	12	340	54	49	St	10	1000	3
L-1	37-11.2	122-37.5	15 May	0942								
	37-11.0	122-37.4	15 May	1030								
L-2	37-11.1	122-35.8	15 May	1100								
	37-11.1	122-35.8	15 May	1145								
L-3	37-11.0	122-33.0	15 May	1220								
	37-10.6	122-32.7	15 May	1305								
L-4	37-11.1	122-32.0	15 May	1325								
	37-10.4	122-31.4	15 May	1445								
			15 May	1400	14	330	50	53	St	10	800	4

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
L-5	37-10.7	122-30.1	15 May	1505								
	37-11.2	122-29.5	15 May	1630								
L-6	37-10.7	122-29.5	15 May	1701								
	37-10.3	122-28.7	15 May	1811								
L-7	37-10.1	122-28.7	15 May	1837								
	37-10.1	122-28.8	15 May	1920								
L-8	37-11.2	122-26.8	15 May	1935								
	37-10.7	122-26.6	15 May	2008								
			15 May	2000	16	340	51	49	St	10	1000	4
L-9	37-11.3	122-25.7	15 May	2034								
	37-11.0	122-25.4	15 May	2100								
M-1	37-16.1	122-27.4	15 May	2157								
	37-15.8	122-27.2	15 May	2220								
M-2	37-20.7	122-29.5	15 May	2309								
	37-20.5	122-29.7	15 May	2340								
			16 May	0000	12	350	49	46	St	10	500	3
M-3	37-25.7	122-30.8	16 May	0032								
	37-25.3	122-30.8	16 May	0120								

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
			16 May	0200	10	330	50	49	St	10	500	4
N-1	37-32.1	122-33.7	16 May	0220								
	37-32.5	122-33.5	16 May	0318								
N-2	37-32.5	122-35.5	16 May	0456								
	37-32.7	122-35.6	16 May	0552								
			16 May	0600	8	340	49	46	St	10	500	4
N-3	37-32.5	122-37.0	16 May	0627								
	37-32.2	122-36.6	16 May	0700								
N-4	37-32.4	122-38.2	16 May	0720								
	37-32.2	122-38.2	16 May	0750								
N-5	37-32.2	122-39.5	16 May	0822								
	37-32.2	122-39.5	16 May	0845								
N-6	37-32.3	122-41.0	16 May	0855								
	37-32.2	122-41.0	16 May	0925								
N-7	37-32.2	122-42.5	16 May	0935								
	37-32.2	122-42.5	16 May	1035								
			16 May	1000	6	325	50	46	St	10	500	4

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
N-8	37-32.3	122-46.4	16 May	1132								
	37-32.1	122-46.4	16 May	1215								
N-9	37-32.3	122-50.2	16 May	1254								
	37-32.0	122-49.8	16 May	1349								
			16 May	1400	13	320	53	50	St	10	500	3
N-10	37-32.2	122-54.5	16 May	1428								
	37-31.9	122-54.0	16 May	1556								
N-11	37-32.5	122-58.8	16 May	1640								
	37-31.7	122-58.5	16 May	1730								
N-12	37-32.6	123-02.7	16 May	1803								
	37-31.7	123-02.1	16 May	1845								
N-13	37-32.6	123-09.2	16 May	1930								
	37-32.0	123-09.1	16 May	2019								
			16 May	2000	16	325	53	50	Cs	10	2000	3
N-14	37-32.8	123-23.3	16 May	2300								
			17 May	0000	9	325	52	48		CLEAR		3
O-1	37-36.8	123-15.8	17 May	0142								
	37-38.8	123-16.0	17 May	0210								

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
O-2	37-41.8	123-09.0	17 May	0327								
	37-41.4	123-09.0	17 May	0420								
			17 May	0600	6	200	51	48		CLEAR		3
O-3	37-48.2	123-00.7	17 May	0545								
	37-48.2	123-00.5	17 May	0621								
P-1	37-53.7	122-53.0	17 May	0735								
	37-53.6	122-53.0	17 May	0815								
P-2	37-53.6	122-48.0	17 May	0850								
	37-53.6	122-48.0	17 May	0927								
			17 May	1000	10	165	52	48	St	10	500	2
R-1	37-49.7	122-47.4	17 May	1157								
	37-50.0	122-46.8	17 May	1316								
			17 May	1400	8	160	55	51	St	10	500	2
R-2	37-46.9	122-46.3	17 May	1411								
	37-47.3	122-45.9	17 May	1500								
R-3	37-44.0	122-44.0	17 May	1540								
	37-44.6	122-44.0	17 May	1620								
			17 May	2000	12	260	53	52	St	10	500	2

TABLE 1

STATION	POSITION		DATE	TIME (PDT)	WIND SPEED (KTS)	WIND DIRECTION (°T)	TEMPERATURE		CLOUDS			SEA STATE
	LATITUDE (N)	LONGITUDE (W)					WET (°F)	DRY (°F)	TYPE	COVER (10th)	HEIGHT (FT)	
R-4	37-41.0	122-41.5	17 May	2230								
	37-41.0	122-41.5	17 May	2310								
S-1	37-38.5	122-39.7	17 May	2340								
	37-38.5	122-39.7	18 May	0015								
			18 May	0000	10	160	52	48	St	10	500	2
S-2	37-38.2	122-36.1	18 May	0035								
	37-38.2	122-36.1	18 May	0110								

TABLE 2

RAMSEY PROBE DEPTH, TIME, SOUND VELOCITY, AND TEMPERATURE

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
STATION D-6 (1)							
				0	0044	1495.	11.43
1	0028	1495.2	11.41	1	0044	1495.2	11.42
2	0028	1495.2	11.42				
3	0028	1495.2	11.40	3	0037	1495.2	11.39
4	0028	1495.4	11.42				
8	0029	1495.4	11.45	8	0037	1495.	11.37
10	0029	1495.9	11.42	10	0037	1495.2	11.31
13	0030	1494.9	11.26				
16	0030	1492.9	10.71	16	0036	1492.	10.54
21	0030	1491.9	10.26				
22	0030	1491.9	10.22	22	0036	1491.6	10.17
28	0031	1489.9	9.68	28	0036	1489.4	9.61
32	0031	1489.2	9.59	32	0036	1489.9	9.48
36	0032	1489.9	9.47				
42	0032	1489.9	9.43				
STATION D-6 (2)							
0	0032	1495.4	11.47	0	0359	1495.	11.45
2	0333	1495.4	11.47	2	0356	1495.2	11.39
3	0333	1495.4	11.45	3	0355	1495.2	11.39
6	0333	1495.4	11.42				
8	0333	1495.	11.41	8	0353	1495.2	11.38
10	0333	1495.2	11.39	10	0353	1495.9	11.29
11	0334	1495.9	11.31				
12	0334	1495.8	11.31				
13	0334	1495.9	11.35	13	0353	1494.	11.11
16	0334	1494.	11.26	16	0353	1493.8	10.86
17	0334	1494.8	11.08				
19	0334	1492.8	10.84	19	0353	1493.	10.72
22	0335	1492.9	10.39	22	0352	1492.2	10.42
23	0336	1492.8	10.38	23	0351	1492.9	10.42
26	0336	1492.8	10.38	26	0350	1492.8	10.33
30	0336	1491.8	10.35				
31	0336	1490.4	9.88	31	0349	1489.8	9.69
32	0337	1490.4	9.88				
34	0337	1490.2	9.82				
37	0337	1489.6	9.68	37	0349	1489.2	9.52
39	0337	1489.4	9.59	39	0348	1489.2	9.50
41	0337	1489.4	9.54				
42	0338	1489.4	9.54	42	0348	1489.2	9.50
45	0338	1489.	9.51	45	0348	1489.9	9.44
47	0338	1489.2	9.47				
49	0338	1489.8	9.42	49	0347	1489.8	9.41

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
50	0339	1489.9	9.38	50	0347	1489.2	9.42
51	0339	1489.9	9.38				
52	0339	1489.9	9.37	52	0347	1489.2	9.41
53	0339	1489.9	9.36	53	0347	1489.9	9.39
55	0339	1489.8	9.34	55	0346	1489.9	9.38
57	0339	1489.8	9.33				
60	0340	1488.8	9.27				
61	0340	1488.8	9.26				
64	0340	1488.	9.24	64	0345	1488.8	9.27
70	0341	1488.	9.20	70	0344	1488.8	9.20
71	0341	1488.9	9.11	71	0344	1488.	9.18
75	0342	1488.2	9.04	75	0343	1488.2	9.02
77	0342	1488.2	9.02				

STATION D-7

DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
0	0514	1493.9	11.05				
1	0514	1493.9	11.05	1	0530	1492.2	11.60
3	0514	1494.8	11.05				
4	0514	1494.8	11.05				
5	0515	1494.8	11.06				
9	0515	1494.9	11.04	9	0529	1494.9	11.07
13	0516	1494.9	11.03				
14	0516	1494.9	11.03	14	0529	1494.9	11.02
18	0516	1493.9	11.01				
22	0516	1493.	10.86				
23	0516	1493.8	10.69	23	0527	1491.9	10.28
24	0517	1493.8	10.68				
25	0517	1492.8	10.63				
28	0517	1491.9	10.14	28	0526	1491.4	10.16
31	0517	1490.9	10.08	31	0526	1490.	9.82
33	0517	1490.6	9.89				
35	0518	1490.9	9.83				
40	0518	1489.8	9.70	40	0526	1489.9	9.59
44	0518	1489.9	9.57	44	0525	1489.9	9.51
45	0519	1489.9	9.55				
48	0519	1489.	9.52	48	0524	1489.8	9.41
52	0519	1488.	9.40	52	0524	1488.8	9.25
53	0519	1488.6	9.25				
55	0520	1488.6	9.24	55	0524	1488.6	9.22
63	0520	1488.9	9.16	63	0523	1488.9	9.16
65	0521	1488.9	9.16	65	0523	1488.6	9.17
69	0521	1488.9	9.13	69	0522	1488.9	9.15
70	0521	1488.9	9.13				
73	0522	1488.4	9.10	73	0522	1488.9	9.11
74	0522	1488.9	9.11				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
			STATION D-8				
0	0647	1494.2	11.13				
1	0647	1494.9	11.13	1	0703	1494.8	11.07
3	0648	1494.9	11.10	3	0703	1494.8	11.07
7	0648	1494.9	11.08	7	0702	1494.9	11.06
11	0648	1494.9	11.08				
12	0648	1494.8	10.96	12	0702	1493.9	10.92
14	0649	1493.9	10.93				
17	0649	1492.9	10.72	17	0702	1492.6	10.59
21	0649	1491.2	10.46	21	0701	1491.	10.21
23	0649	1490.6	10.01	23	0701	1491.9	10.06
25	0650	1490.6	10.00	25	0701	1490.	9.98
29	0650	1490.	9.90	29	0700	1490.2	9.80
32	0650	1490.8	9.73				
34	0650	1489.9	9.71				
36	0650	1489.6	9.64				
42	0651	1489.9	9.42	42	0658	1489.6	9.51
43	0651	1489.8	9.40				
46	0651	1488.6	9.38				
49	0651	1488.9	9.23	49	0658	1488.9	9.25
53	0652	1488.4	9.18	53	0657	1488.9	9.19
56	0652	1488.4	9.15	56	0657	1488.4	9.15
60	0652	1488.4	9.13	60	0656	1488.	9.12
63	0653	1488.2	9.10	63	0655	1488.	9.11
65	0653	1488.9	9.08	65	0655	1488.2	9.09
69	0653	1488.9	9.05				
72	0653	1488.8	8.98	72	0654	1487.9	8.97
74	0654	1487.9	8.97				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
STATION F-3							
0	2237	1494.9	11.27				
2	2240	1494.8	11.31				
5	2241	1494.	11.18				
				10	2254	1493.8	10.99
16	2242	1493.9	10.88				
				20	2253	1493.2	10.78
22	2243	1493.4	10.78				
				30	2252	1492.	10.59
32	2244	1492.8	10.60				
39	2245	1492.4	10.46				
				41	2252	1492.	10.52
46	2245	1491.4	10.11				
				50	2250	1491.6	10.12
56	2246	1490.9	9.90				
				60	2249	1490.	9.81
66	2247	1489.	9.40				
70	2248	1489.9	9.29				
STATION G-1							
0	0228	1495.9	11.48				
6	0230	1494.	11.23				
				12	0248	1493.	10.89
18	0231	1493.	10.85				
19	0231	1493.2	10.85				
				25	0246	1493.8	10.74
30	0232	1493.8	10.70				
				37	0244	1493.8	10.66
42	0233	1492.9	10.49				
				48	0242	1492.9	10.46
54	0234	1492.6	10.47				
				60	0240	1491.6	10.15
66	0235	1491.9	9.94				
				71	0239	1489.9	9.49
77	0237	1489.9	9.33				
78	0237	1489.9	9.30				
STATION G-2							
3	0506	1495.2	11.49				
				12	0519	1494.2	11.12
16	0507	1494.2	11.12				
				24	0518	1493.	10.76
28	0508	1492.9	10.58				
				36	0517	1492.4	10.46

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
40	0510	1492.	10.43				
				48	0516	1491.6	10.20
53	0510	1490.2	9.79				
				60	0515	1489.8	9.60
65	0511	1489.6	9.53				
				70	0515	1489.4	9.43
77	0512	1489.	9.39				
80	0514	1489.8	9.27				
STATION H-1							
				0	0659	1494.	11.39
5	0649	1494.2	11.26				
6	0649	1494.	11.24				
				15	0658	1493.	11.01
17	0650	1493.6	11.01				
				25	0657	1493.2	10.84
29	0651	1493.2	10.82				
32	0651	1492.8	10.71				
				35	0656	1492.9	10.57
41	0651	1491.	10.23				
				45	0656	1490.9	9.91
50	0651	1490.	9.91				
51	0652	1490.4	9.85				
				56	0655	1490.	9.79
62	0652	1489.6	9.60				
				68	0654	1489.9	9.49
74	0653	1489.4	9.46				
76	0653	1489.	9.37				
77	0654	1489.2	9.38				
STATION H-2							
0	0822	1492.2	10.61				
				4	0847	1493.2	10.84
6	0823	1491.9	10.49	6	0845	1491.9	10.36
				10	0843	1491.4	10.32
12	0826	1491.2	10.23	12	0842	1491.8	10.39
				15	0841	1491.8	10.38
17	0827	1491.9	10.19	17	0841	1491.	10.31
				19	0840	1491.	10.22
23	0828	1491.	10.19				
				24	0838	1491.	10.19
29	0829	1491.4	10.18	29	0837	1491.	10.17
34	0829	1490.9	9.94				
41	0830	1490.2	9.81				
				49	0835	1489.9	9.54
52	0830	1489.6	9.57				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
				59	0834	1488.	9.27
63	0831	1488.6	9.23				
				69	0833	1488.9	9.19
75	0832	1488.	9.17				
81	0832	1488.2	9.03				
			STATION H-3				
1	1038	1495.	11.46				
2	1038	1495.	11.48				
4	1039	1495.8	11.38				
5	1039	1495.9	11.38				
6	1040	1494.9	11.34				
11	1041	1493.8	11.00				
16	1042	1492.9	10.70				
22	1043	1492.2	10.46				
28	1044	1490.	10.00				
29	1044	1490.	9.98				
34	1045	1490.9	9.80				
44	1046	1488.	9.34				
55	1047	1488.9	9.11				
66	1047	1487.2	8.83				
76	1048	1486.8	8.64				
			STATION H-4				
0	1145	1495.9	11.59				
3	1146	1494.2	11.22				
6	1147	1494.9	11.36				
				8	1206	1495.6	11.53
10	1148	1493.8	10.76				
				14	1205	1493.4	10.81
17	1149	1492.	10.49				
18	1149	1492.2	10.49				
23	1150	1492.2	10.44				
				25	1204	1492.9	10.49
30	1152	1490.8	10.06				
34	1153	1489.4	9.60				
				35	1202	1489.9	9.71
				41	1202	1488.9	9.44
45	1154	1488.8	9.17				
51	1155	1486.9	8.83				
56	1156	1486.8	8.72				
				57	1200	1486.8	8.74
62	1156	1486.9	8.61				
67	1157	1486.9	8.52				
				74	1159	1485.8	8.37

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
				79	1158	1485.9	8.37
80	1158	1485.9	8.36				
STATION H-5							
2	1423	1486.8	11.95				
5	1424	1484.9	11.67				
7	1425	1484.9	11.43				
				8	1452	1484.9	11.37
12	1426	1483.8	11.24	12	1449	1483.	11.09
13	1426	1483.9	11.25	13	1449	1483.	11.05
15	1427	1483.4	11.11				
18	1428	1482.9	10.96	18	1448	1479.8	10.04
25	1430	1479.8	10.06	25	1448	1479.8	9.79
30	1432	1478.9	9.73				
36	1433	1477.	9.36	36	1447	1476.8	9.09
47	1434	1476.2	8.88	47	1446	1475.9	8.68
53	1437	1475.6	8.67	53	1445	1475.6	8.70
57	1438	1475.	8.69				
65	1440	1476.8	8.75	65	1444	1476.2	8.77
71	1441	1476.2	8.75				
77	1443	1476.2	8.73				
STATION H-6							
0	1603	1486.	12.14	0	1625	1487.2	12.30
8	1606	1485.8	11.86				
				10	1624	1483.8	11.19
13	1607	1483.4	11.17				
				16	1621	1482.	10.50
19	1608	1482.4	10.83				
25	1608	1479.8	9.80				
31	1610	1478.8	9.48				
				36	1619	1477.2	9.01
38	1611	1476.8	9.10				
44	1611	1476.6	9.00				
50	1612	1476.	8.98				
57	1612	1476.8	8.98				
62	1613	1476.8	8.96				
68	1614	1476.8	8.94				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
STATION H-7							
5	1750	1485.8	11.63				
8	1751	1484.8	11.54				
				9	1805	1484.9	11.47
14	1751	1483.8	11.23				
				15	1804	1483.6	11.12
20	1753	1482.9	10.73	20	1803	1481.2	10.40
23	1753	1481.	10.46				
25	1755	1480.9	10.13				
29	1755	1478.9	9.72				
32	1756	1478.2	9.56	32	1801	1478.4	9.58
38	1757	1478.9	9.47				
44	1758	1477.9	9.37				
49	1759	1477.8	9.34				
STATION H-8							
5	1854	1486.	12.02				
7	1854	1486.9	11.91				
				11	1903	1484.9	11.37
13	1856	1483.9	11.24	13	1903	1484.8	11.26
19	1857	1481.6	10.55				
24	1858	1479.6	9.95	24	1902	1479.9	9.91
28	1859	1479.9	9.82				
				29	1902	1479.9	9.76
30	1900	1479.9	9.79				
36	1901	1479.8	9.73				
STATION I-1							
1	2022	1487.2	12.28				
2	2023	1487.9	12.39				
5	2024	1487.8	12.23				
7	2025	1483.2	11.12				
				10	2034	1482.	10.90
13	2025	1481.9	10.69				
				15	2033	1481.9	10.64
18	2027	1480.9	10.38				
23	2028	1479.9	9.80				
29	2028	1479.8	9.75				
35	2030	1479.8	9.72				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (^oC)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (^oC)
STATION I-2							
1	2115	1484.4	11.48				
5	2117	1483.6	11.30				
7	2118	1482.8	10.78				
10	2119	1481.2	10.52				
12	2120	1481.2	10.48				
15	2121	1481.8	10.39				
18	2122	1480.6	10.28				
21	2123	1480.8	10.28				
25	2124	1480.9	10.34				
28	2124	1480.2	10.08				
30	2125	1479.	9.97				
STATION J-1							
0	2218	1484.9	11.31				
4	2222	1481.9	10.30				
13	2224	1479.8	9.85				
19	2225	1478.4	9.65				
25	2226	1478.8	9.51				
28	2226	1478.8	9.49				
STATION J-2							
				0	2343	1482.6	10.94
3	2331	1482.6	10.94				
6	2333	1482.6	10.94				
12	2333	1482.6	10.91				
				17	2342	1480.8	10.36
				20	2340	1480.9	10.24
23	2334	1481.2	10.47				
				25	2339	1478.9	9.68
				29	2338	1478.9	9.65
33	2335	1478.8	9.48				
				39	2338	1477.	9.35
44	2336	1477.4	9.23				
STATION J-3							
0	0050	1484.	11.54				
6	0052	1483.8	11.29				
12	0053	1482.9	10.95				
				13	0108	1482.2	10.76
18	0054	1482.9	10.75				
				20	0107	1480.9	10.16

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
22	0054	1480.9	10.40				
28	0055	1480.8	10.10				
33	0056	1479.8	9.80				
38	0058	1477.9	9.43				
45	0059	1477.2	9.21				
49	0059	1477.8	9.10				
55	0100	1476.	9.01				
61	0101	1476.8	9.00				
67	0103	1476.8	9.00				
STATION J-4							
0	0206	1484.8	11.61				
5	0207	1483.8	11.27				
11	0208	1481.8	10.67				
17	0211	1479.6	10.02				
28	0213	1477.	9.47				
38	0214	1477.9	9.22				
50	0216	1476.9	8.86				
				55	0222	1476.2	8.85
60	0217	1476.4	8.89				
65	0218	1476.4	8.86				
72	0220	1476.9	8.86				
STATION J-5							
0	0316	1482.6	10.99				
2	0317	1481.6	10.58				
5	0319	1481.	10.68				
11	0320	1481.9	10.50				
16	0321	1479.2	9.90				
21	0322	1478.6	9.73				
27	0323	1477.2	9.33				
33	0324	1476.9	9.19				
38	0325	1476.9	9.14				
44	0326	1476.6	9.06				
49	0327	1476.	8.95				
54	0329	1476.9	8.84				
60	0329	1475.9	8.76				
67	0330	1476.9	8.77				
72	0331	1476.8	8.74				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
STATION J-6							
7	0449	1483.8	11.28				
				8	0510	1483.6	11.23
11	0450	1483.4	11.13				
				14	0509	1483.	11.10
18	0453	1482.4	10.87	18	0508	1482.4	10.79
23	0454	1481.4	10.53				
28	0455	1480.9	10.16				
				30	0506	1479.2	9.85
33	0456	1479.2	9.84				
40	0457	1477.9	9.46				
44	0457	1477.	9.34				
50	0458	1477.	9.21				
55	0459	1477.8	9.10	55	0502	1477.8	9.07
60	0500	1476.9	8.94				
65	0500	1476.2	8.83				
71	0501	1475.9	8.73				
78	0502	1476.8	8.69				
STATION J-7							
6	0641	1482.4	10.94				
				7	0652	1481.2	10.56
12	0641	1482.2	10.83	12	0651	1480.2	10.23
				15	0650	1479.2	9.90
18	0642	1479.9	10.04				
				22	0649	1477.9	9.36
23	0642	1478.2	9.65				
30	0643	1477.2	9.27				
				33	0648	1476.4	9.04
36	0644	1476.6	9.12				
42	0644	1476.4	9.00				
48	0645	1476.9	8.97				
53	0645	1476.2	8.87				
60	0645	1476.2	8.84				
65	0646	1476.2	8.84				
70	0646	1476.9	8.88				
77	0647	1476.9	8.87				
STATION J-8							
0	0808	1484.4	11.45				
3	0809	1484.8	11.37				
5	0810	1483.8	11.31				
12	0811	1482.	10.86				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
17	0813	1481.8	10.64				
22	0813	1481.2	10.46				
28	0814	1478.4	9.61				
34	0814	1478.8	9.49				
50	0816	1476.8	8.84				
61	0818	1475.6	8.64				
73	0819	1475.6	8.60				
			STATION J-9				
0	0916	1485.9	11.63				
5	0919	1484.9	11.42				
10	0919	1481.7	10.68				
16	0921	1481.6	10.57				
20	0921	1480.8	10.34				
24	0922	1480.2	10.14				
27	0922	1478.6	9.70				
33	0923	1478.8	9.47				
44	0924	1477.9	9.15				
55	0925	1476.8	9.01				
66	0925	1476.9	8.76				
71	0926	1475.9	8.67				
			STATION J-10				
0	1045	1483.	11.16				
3	1046	1483.6	11.23				
5	1047	1482.2	10.83				
9	1048	1480.8	10.42	9	1058	1480.8	10.43
12	1048	1480.8	10.39				
				15	1057	1480.8	10.37
18	1048	1480.6	10.29				
24	1049	1480.9	10.23				
				27	1056	1480.	10.24
30	1049	1480.	10.25				
37	1050	1480.2	10.08				
43	1050	1479.2	9.81				
49	1051	1478.9	9.66				
				50	1055	1477.8	9.32
55	1051	1477.	9.26	55	1055	1477.9	9.18
60	1052	1477.4	9.16				
68	1053	1477.2	9.09				
74	1053	1476.8	8.91				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
			STATION L-5				
0	1507	1486.5	INOPERATIVE				
4	1508	1486.5					
14	1508	1486.2					
22	1509	1485.9					
27	1511	1482.5					
35	1512	1480.1					
40	1512	1479.5					
48	1513	1479.2					
58	1514	1479.3					
64	1515	1479.2					
70	1517	1479.3					
78	1519	1479.4					
85	1521	1479.4					
			STATION L-6				
				2	1730	1486.4	INOPERATIVE
4	1704	1486.5	INOPERATIVE				
6	1706	1486.7					
11	1707	1486.6		11	1729	1486.6	
13	1708	1486.6					
				15	1729	1486.5	
19	1708	1481.3					
				20	1729	1486.5	
22	1713	1486.3		22	1729	1486.5	
25	1713	1485.0					
				29	1728	1482.9	
				35	1728	1481.0	
				40	1728	1479.9	
43	1715	1479.9					
48	1720	1479.7		48	1727	1479.9	
55	1722	1479.5					
60	1723	1479.5					
70	1723	1479.7					
			STATION L-7				
0	1841	1485.7	INOPERATIVE	0	1857	1485.7	INOPERATIVE
2	1841	1485.7					
5	1844	1485.7					
10	1844	1485.7					
12	1845	1485.7					
16	1847	1485.4					
19	1847	1482.2					
24	1848	1482.3					
26	1849	1482.3					
33	1850	1481.6					

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
40	1850	1480.0	INOPERATIVE				
46	1851	1479.8					
52	1851	1479.8					
58	1852	1479.7					
64	1853	1479.8					
STATION L-8							
0	1937	1484.8	INOPERATIVE				
4	1937	1485.0					
6	1938	1485.0					
9	1938	1485.0					
10	1938	1485.1					
12	1939	1485.0					
13	1939	1485.1					
18	1939	1485.1					
24	1940	1483.4					
32	1941	1482.1					
33	1941	1482.0					
39	1942	1481.3					
45	1943	1480.3					
52	1944	1479.9					
56	1945	1479.9					
61	1945	1433.4					
STATION L-9							
0	2037	1484.1	INOPERATIVE				
1	2038	1484.1					
5	2040	1484.1					
8	2041	1483.9					
9	2041	1483.8					
13	2042	1483.8					
17	2044	1483.9					
18	2044	1484.0					
21	2045	1484.0					
24	2046	1484.1					
25	2047	1484.2					
29	2047	1484.2					
34	2048	1481.4					
35	2048	1481.3					

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
STATION M-1							
0	2200	1486.4	11.16				
4	2201	1486.4	11.15				
5	2201	1486.5	11.17				
8	2202	1486.3	11.07				
9	2202	1486.3	11.09				
12	2203	1483.0	10.03				
13	2203	1483.2	10.19				
17	2204	1482.3	9.94				
20	2204	1482.3	9.88				
21	2204	1482.2	9.87				
25	2205	1482.2	9.84				
28	2205	1482.2	9.82				
STATION M-2							
1	2313	1488.3	11.70				
5	2314	1488.3	11.71				
9	2315	1487.6	11.50				
13	2316	1485.2	10.77				
14	2316	1485.3	10.83				
17	2317	1482.3	9.97				
21	2318	1481.9	9.97				
25	2319	1481.6	9.65				
28	2320	1481.3	9.57				
31	2320	1481.3	9.56				
36	2321	1481.3	9.55				
40	2321	1481.3	9.52				
STATION M-3							
0	0033	1487.6	11.51				
4	0034	1487.5	11.48				
5	0034	1487.5	11.49				
9	0035	1487.3	11.41				
13	0036	1483.4	10.28				
17	0037	1482.5	9.98				
21	0038	1481.9	9.80				
25	0039	1481.0	9.53				
28	0040	1480.7	9.37				
29	0040	1480.7	9.41				
32	0040	1480.4	9.29				
37	0042	1480.4	9.29				
39	0042	1480.5	9.28				
41	0043	1480.5	9.28				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP ($^{\circ}$C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP ($^{\circ}$C)
		STATION N-1					
0	0226	1487.2	11.92				
5	0227	1486.0	11.76				
8	0228	1485.6	10.99				
10	0229	1485.3	10.84				
15	0231	1483.6	10.30				
18	0232	1482.7	10.00				
23	0233	1481.3	9.62				
28	0235	1480.3	9.32				
33	0236	1479.9	9.18				
35	0236	1480.0	9.18				
		STATION N-8					
0	1133	1487.7	12.30				
8	1135	1486.8	11.57				
15	1135	1482.8	10.13				
28	1136	1479.3	9.05				
43	1137	1477.9	8.47				
68	1139	1477.9	8.34				
73	1140	1477.9	8.32				
		STATION N-9					
0	1257	1489.1	11.48				
7	1257	1485.8	10.29				
13	1258	1482.0	8.91				
20	1258	1480.9	8.54				
28	1259	1480.1	8.27				
42	1300	1478.7	7.79				
57	1301	1478.0	7.51				
71	1301	1477.5	7.31				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
			STATION N-10				
0	1428	1486.8	10.66				
7	1429	1483.6	9.42				
15	1431	1482.1	8.92				
30	1432	1480.9	8.48				
41	1434	1480.1	8.21				
54	1435	1479.1	7.84				
65	1436	1478.5	7.56				
75	1437	1477.8	7.37				
91	1507	1477.3	7.13				
98	1508	1477.3	7.12				
			STATION N-11				
0	1639	1483.0	11.42	0	1659	1483.0	11.42
				3	1659	1483.1	11.41
				6	1659	1483.1	11.41
				10	1658	1483.1	11.35
				11	1658	1483.0	11.28
				12	1658	1482.8	11.17
				13	1658	1482.0	10.61
				15	1658	1478.5	9.47
16	1640	1476.8	9.60	16	1658	1476.8	9.31
				20	1657	1476.3	9.18
				25	1657	1475.8	9.04
				27	1657	1475.7	8.99
				30	1657	1475.4	8.90
				34	1656	1475.2	8.84
				37	1656	1475.4	8.84
				40	1656	1475.3	8.75
				45	1655	1475.1	8.71
				48	1655	1474.8	8.59
				50	1655	1474.5	8.52
				56	1655	1474.5	8.49
				61	1654	1474.3	8.39
				65	1654	1474.0	8.30
				70	1653	1474.0	8.28
				76	1653	1474.1	8.27
83	1645	1474.2	8.27	83	1652	1474.1	8.25
				91	1651	1474.2	8.23
				100	1651	1474.3	8.22
				107	1650	1474.4	8.21
				117	1648	1474.5	8.19

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
		STATION N-12					
0	1802	1481.8	10.93				
2	1803	1481.9	10.94				
4	1804	1481.9	10.95				
8	1804	1481.6	10.91				
10	1804	1479.9	10.70				
12	1804	1477.6	10.12				
14	1804	1476.7	9.50				
16	1804	1476.4	9.34				
22	1804	1476.3	9.21				
25	1805	1476.3	9.26				
31	1805	1476.2	9.23				
36	1805	1475.9	9.15				
40	1805	1476.2	9.11				
47	1806	1475.7	8.98				
53	1806	1475.9	8.97				
61	1806	1475.7	8.92				
65	1807	1476.0	8.92				
70	1807	1475.8	8.88				
75	1807	1475.7	8.78				
80	1808	1475.7	8.77				
85	1808	1475.2	8.71				
90	1808	1475.1	8.54				
95	1810	1474.9	8.50				
98	1810	1474.8	8.43				
		STATION N-13					
0	1934	1482.3	11.05	0	1945	1482.1	11.03
3	1935	1482.1	11.03				
				4	1945	1482.0	10.96
12	1935	1481.8	11.01				
16	1935	1480.4	10.53				
				17	1944	1480.7	10.24
24	1936	1476.8	9.54				
				27	1944	1471.8	9.36
32	1936	1476.7	9.40				
38	1936	1476.9	9.38	38	1944	1476.6	9.28
46	1937	1476.7	9.31				
				48	1943	1476.9	9.29
52	1937	1476.9	9.32				
65	1938	1477.0	9.23				
				67	1943	1476.8	9.21
72	1938	1476.8	9.16				
84	1939	1476.7	9.10				
				86	1942	1476.4	8.93

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
89	1939	1476.4	8.95				
				93	1942	1476.3	8.87
96	1940	1476.1	8.86				
102	1941	1475.6	8.67				
			STATION N-14				
0	2146	1484.8	12.01				
6	2147	1484.2	11.96				
13	2147	1481.2	11.03				
20	2147	1480.3	10.79				
26	2147	1479.6	10.35				
33	2147	1478.5	10.29				
40	2147	1478.3	9.87				
46	2147	1478.1	9.82				
52	2147	1478.0	9.66				
59	2147	1477.5	9.56				
65	2147	1477.3	9.39				
72	2148	1477.0	9.28				
79	2148	1477.2	9.24				
85	2148	1476.8	9.18				
105	2148	1476.7	8.95				
201	2149	1475.9	8.53				
303	2149	1474.5	7.05				
			STATION O-1				
0	0142	1481.4	11.00				
8	0144	1481.5	10.97				
14	0145	1481.6	10.97				
22	0146	1481.3	10.84				
29	0147	1478.0	9.88				
36	0148	1477.5	9.64				
49	0150	1477.1	9.36				
62	0151	1476.1	9.02				
81	0152	1476.9	9.13				
93	0153	1476.2	8.89				
95	0153	1476.1	8.88				
107	0155	1476.1	8.80				
119	0156	1476.4	8.79				
121	0156	1476.4	8.79				
132	0157	1475.9	8.59				
			STATION O-2				
1	0329	1482.9	11.44				
9	0330	1483.2	11.45				
16	0331	1481.3	10.79				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
23	0333	1479.7	10.27				
30	0334	1477.8	9.70				
45	0335	1476.2	9.13				
60	0336	1476.0	8.99				
73	0338	1475.5	8.76				
89	0339	1475.4	8.64				
105	0341	1475.0	8.46				
119	0342	1474.8	8.34				
133	0344	1474.5	8.20				
147	0346	1474.7	8.16				
171	0349	1474.8	8.10				
STATION O-3							
0	0545	1482.5	11.30				
7	0547	1478.0	9.84				
15	0547	1476.0	9.25				
22	0548	1475.8	9.10				
31	0549	1475.2	8.91				
38	0550	1475.0	8.79				
45	0551	1474.7	8.72				
52	0551	1474.6	8.61				
59	0552	1474.2	8.43				
STATION P-1							
1	0742	1481.1	10.80				
4	0743	1481.1	10.79				
10	0743	1481.1	10.76				
14	0744	1479.4	10.51				
15	0744	1477.7	9.99				
19	0744	1476.2	9.30				
20	0744	1475.8	9.13				
25	0745	1475.6	9.01				
30	0745	1474.9	8.77				
33	0746	1474.9	8.75				
37	0746	1474.5	8.66				
40	0747	1474.5	8.62				
45	0747	1474.5	8.59				
50	0748	1474.6	8.57				
STATION P-2							
0	0903	1481.1	10.97				
1	0903	1481.1	10.99				
12	0906	1476.3	9.29				
21	0907	1474.8	8.81				
32	0909	1474.7	8.70				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
			STATION R-1				
0	1211	1481.9	11.42				
3	1214	1481.7	11.23				
5	1214	1481.9	11.22				
10	1217	1480.3	10.47				
14	1219	1479.8	10.34				
20	1220	1476.1	9.21				
25	1221	1474.7	8.75				
29	1222	1474.6	8.68				
33	1223	1474.6	8.66				
36	1224	1474.6	8.65				
39	1224	1474.6	8.65				
41	1225	1474.6	8.65				
			STATION R-2				
0	1414	1482.2	11.80				
4	1416	1482.0	11.84				
5	1416	1481.2	11.54				
9	1416	1480.6	11.21				
11	1416	1480.5	11.02				
15	1417	1477.6	10.04				
17	1417	1477.1	9.60				
20	1417	1476.3	9.25				
23	1417	1475.3	9.10				
25	1417	1475.1	8.83				
29	1417	1475.0	8.79				
34	1418	1475.0	8.74				
36	1418	1474.9	8.72				
			STATION R-3				
2	1549	1482.5	11.95	2	1554	1482.5	11.99
5	1549	1481.4	11.57	5	1554	1482.1	11.77
9	1550	1479.9	10.96	9	1553	1478.5	9.85
10	1550	1478.8	10.37				
14	1550	1477.8	9.77	14	1553	1477.9	9.67
17	1550	1476.2	9.36	17	1552	1476	9.30
20	1550	1475.1	8.93	20	1552	1475.3	8.93
25	1551	1474.5	8.69				
27	1551	1474.4	8.65	27	1552	1474.3	8.64
29	1551	1474.4	8.64				

TABLE 2 (Continued)

DOWN				UP			
DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)	DEPTH (M)	TIME (PDT)	S/V (M/SEC)	TEMP (°C)
			STATION R-4				
0	2246	1482.5	11.88				
3	2247	1482.0	11.78				
5	2247	1479.8	11.23	5	2252	1477.9	9.77
8	2247	1478.0	9.95				
10	2247	1477.5	9.75	10	2252	1476.9	9.41
15	2247	1475.1	9.00	15	2251	1474.9	8.84
19	2248	1474.6	8.75	19	2251	1474.6	8.71
23	2248	1474.5	8.69	23	2251	1474.5	8.68
28	2248	1474.7	8.69	28	2250	1474.7	8.70
30	2248	1474.8	8.70	30	2250	1474.7	8.70
35	2249	1474.8	8.70				
			STATION S-1				
0	2349	1482.0	11.34				
11	2352	1478.0	9.82				
14	2352	1477.6	9.54				
18	2352	1475.8	9.05				
20	2352	1475.7	9.05				
22	2352	1475.4	8.93				
25	2353	1475.2	8.84				
			STATION S-2				
				0	0053	1483.4	12.20
				5	0053	1482.3	11.51
9	0049	1480.2	10.47	9	0052	1481.9	11.06
10	0049	1479.8	10.29	10	0052	1481.2	10.44
13	0050	1478.9	10.00	13	0052	1479.8	10.17
15	0050	1478.6	9.90	15	0052	1479.0	9.93
17	0050	1477.1	9.55	17	0052	1478.5	9.73
22	0050	1475.9	9.09	22	0051	1475.9	9.05
24	0051	1475.9	9.05				

TABLE 3

BEAM TRANSMITTANCE DATA

STATION D-1

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
2.4	0.0	0.0
5.4	0.0	
7.4	0.0	
9.4	2.2	22.4
10.4		41.5
11.4		51.4
12.4	73.8	
13.4		29.0
14.4		43.7
15.4	15.9	40.9
17.4		21.6
18.4		15.6
20.4	6.5	21.7

STATION D-6(2)

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
2.4	25.2	
4.4	27.9	
7.4		49.4
12.4	39.0	
15.2	63.2	
17.4	51.2	
22.4	64.2	
24.4		62.3
27.4	60.7	
32.4	69.1	
37.4		61.8
42.4	70.3	
47.4		62.9
52.4	60.4	
57.4		65.6
62.4	69.5	
67.4		69.0
72.4	73.6	
77.4	70.8	

STATION D-7

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
2.4		59.5
7.4	63.5	
12.4		54.1
17.4	65.0	
22.4		63.0
27.4	73.6	
32.4		72.5
37.4	58.8	
42.4		55.9
47.4	61.7	
52.4		55.1
57.4	59.5	
62.4		62.3
67.4		68.1
72.4		69.2
77.4	70.8	

STATION D-8

2.4		71.3
7.4	75.4	
12.4		60.1
17.4	79.2	
22.4		78.7
27.4	73.9	
32.4		78.7
37.4	59.1	
42.4		59.2
47.5	51.0	
52.4		67.9
57.4	80.0	
62.4		81.4
67.4	82.5	
72.4		81.9
77.4	85.0	

STATION D-9

2.4		58.6
7.4	71.5	
12.4		55.0
17.4	71.1	
22.4		60.0
27.4	73.8	
32.4		70.4
37.4	76.1	
42.4		75.3
47.4	63.8	
52.4		52.2
57.4	38.0	
62.4		43.6
67.4	53.4	
72.4		68.8
77.4	60.8	

STATION D-10

2.4		58.6
7.4	66.0	
12.4		54.3
17.4	63.6	
22.4		45.0
27.4	70.8	
32.4		67.6
37.4	77.2	
42.4		76.8
47.4	78.9	
52.4		79.8
57.4	80.2	
62.4		79.6
67.4	78.9	
72.4		69.6
77.4	75.8	

TABLE 3

STATION D-11

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
2.4		61.5
7.4	62.5	
12.4	63.4	57.5
17.4	60.6	
22.4	69.9	62.5
27.4	74.1	
32.4		71.8
37.4	71.9	
42.4		68.2
47.4	81.0	
52.4		76.7
57.4	78.8	
62.4		81.0
67.4	81.8	
72.4		81.9
77.4	79.0	

STATION D-13

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
2.4	64.1	
7.4		38.0
12.4	57.4	
17.4		77.7
22.4	87.3	
27.4		87.7
32.4	91.0	
37.4		90.4
42.4	88.5	
47.4		87.4
52.4	87.2	

STATION D-14

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
2.4		31.6
7.4	50.4	
12.4		36.8
17.4	59.2	
22.4		62.8
27.4	78.8	
32.4		87.6
37.4	83.1	
42.4		81.6
47.4	83.1	
52.4		83.8
57.4	84.0	
62.4		83.8
67.4	84.0	
72.4		84.0
77.4	84.0	

STATION F-1

2.4		65.0
7.4	64.0	
12.4		60.8
17.4	65.1	
22.4		62.2
27.4	79.3	
32.4		71.9
37.4	82.8	
42.4		82.3
47.4	83.8	
52.4		84.1
57.4	86.9	
62.4		86.8
67.4	86.9	
72.4		87.1
77.4	87.1	

STATION F-2

2.4		44.1
7.4	75.0	
12.4		77.5
17.4	81.1	
22.4		80.1
27.4	83.1	
32.4		85.3
37.4	86.1	
42.4		85.6
47.4	86.4	
52.4		86.3
57.4	87.0	
62.4		84.8
67.4	83.9	
72.4		80.1
77.4	80.1	

STATION F-3

0.0		52.2
2.4		52.6
7.4	39.6	
12.4		65.1
17.4	72.6	
22.4		70.3
27.4	78.5	
32.4		77.4
37.4	79.1	
42.4		79.4
47.4	81.5	
52.4		80.3
57.4	82.1	
62.4		81.8
67.4	82.7	
72.4		82.8

TABLE 3

STATION G-1

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.0		50.4
7.4	63.0	
12.4		61.0
17.4	63.4	
22.4		69.5
27.4	73.4	
32.4		76.7
37.4	77.4	
42.4		74.5
47.4	77.1	
52.4		77.5
57.4	81.7	
62.4		82.1
67.4	79.9	

STATION G-2

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.0		69.3
7.4	74.7	
12.4		73.5
17.4	75.7	
22.4		78.6
27.4	81.6	
32.4		77.4
37.4	84.2	
42.4		77.4
45.4	88.2	
47.4		88.2
52.4	86.6	
57.4		86.0
62.4	86.6	
67.4		87.4
70.4	87.4	

STATION H-1

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
2.4		77.2
7.4	82.8	
12.4		77.3
17.4	78.4	
22.4		70.2
27.4	78.4	
32.4		84.5
37.4	86.1	
42.4		82.3
47.4	80.9	
52.4		80.1
57.4	82.0	
62.4		81.0
67.4	82.9	
70.4		84.0

STATION H-2

2.4	42.3	53.2
7.4	60.3	49.1
12.4	55.2	62.8
17.4	66.6	66.1
22.4	66.7	
27.4	68.9	
32.4	71.2	
37.4	72.2	
42.4		72.9
47.4	72.6	
52.4		73.4
57.4	73.8	
62.4	73.4	
67.4	75.0	
72.4	76.6	

STATION H-3

0.0	65.6
2.4	66.1
5.4	67.4
7.6	68.2
12.4	68.4
17.4	69.1
22.4	72.2
27.4	72.8
32.4	72.4
42.4	74.1
52.4	75.3
62.4	76.3
72.4	77.8

STATION H-4

0.0	62.7	53.3
0.5	63.2	56.0
2.5	65.7	
5.5	74.1	
8.5	74.1	
10.5		68.1
15.5	72.7	
20.5	73.2	62.0
25.5	78.1	
30.5	78.9	71.7
35.5	82.4	78.4
40.5	84.3	
50.5	82.6	81.8
55.5	83.7	
60.5	84.5	
65.5		73.1
70.5	79.7	

TABLE 3

STATION H-5

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.5	63.9	65.0
3.5	63.2	54.0
5.5	58.9	41.2
10.5	40.0	39.0
13.5	43.0	
15.5	50.0	74.0
20.5	80.0	82.0
25.5	84.5	
30.5	87.4	
35.5	89.2	
40.5	76.0	80.0
45.5	89.0	79.2
48.5	78.0	
55.5	62.8	61.0
60.5	63.2	
65.5	59.5	

STATION H-6

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.5	44.2	42.6
3.5	30.7	
5.5	24.3	20.5
10.5	39.4	23.5
15.5	55.1	
18.5	77.7	
20.5	82.8	
25.5	84.4	84.5
30.5	84.4	
35.5	77.5	
40.5	70.8	
45.5	58.1	
50.5	46.6	
55.5	1.0	
61.5	0.0	

STATION H-7

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.5	22.0	23.0
3.5	24.0	27.6
5.5	26.2	
10.5	38.4	30.5
15.5	43.3	59.7
18.5	53.1	
20.5	78.2	
23.5	84.2	
25.5	85.9	84.1
30.5	75.5	
35.5	66.5	
40.5	46.5	

STATION H-8

0.5	23.7	
3.5	23.0	
5.5	28.0	
10.5	37.4	33.0
15.5	42.0	
18.5	48.8	
20.5	53.3	52.5
23.5	49.3	
25.5	48.4	
30.5	40.8	

STATION I-1

0.5	27.8	
1.0	27.8	
3.5	40.3	
5.5	42.7	
7.5		48.1
10.5	50.5	
12.5		49.8
15.5	60.0	
18.5		59.8
20.5	45.8	
22.5		44.0
25.5	50.6	
27.5	48.8	
30.5	42.5	

STATION I-2

0.5	27.1
1.0	27.2
3.5	33.9
5.5	49.5
7.5	51.0
9.5	51.0
12.5	56.4
15.5	55.5
17.5	56.1
19.5	54.8
21.5	56.9
23.5	55.0
25.5	53.7

TABLE 3

STATION J-1

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.0	26.4	
0.5	36.0	
5.5	46.8	
7.5	53.2	
9.5	53.0	
14.5	49.3	
19.5	46.5	
24.5	42.2	
25.5	39.5	

STATION J-2

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.0	28.5	
0.5	28.0	
5.5	29.1	
7.5	28.5	
12.5	28.5	
16.5		45.7
19.5		57.8
22.5	49.0	
24.5		71.7
27.5		71.7
32.5	62.2	
37.5	68.4	
42.5	46.8	

STATION J-3

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.0	29.6	
0.5	29.7	
5.5	29.5	
10.5	29.6	29.1
15.5	31.0	
17.5		57.8
20.5	52.3	
25.5	65.0	
30.5	73.7	
35.5	76.8	
40.5	78.8	
45.5	78.8	
47.5		79.3
50.5	52.8	
55.5		46.3
60.5	44.5	

STATION J-4

0.0	39.5	
0.5	40.4	
5.5	33.2	
7.5		36.5
10.5	68.8	
15.5	74.2	
25.5	77.7	
35.5	78.6	
45.5	79.5	
50.5		76.0
55.5	52.7	
60.5	54.1	
65.5	51.4	

STATION J-5

0.0	55.8	
0.5	55.3	
3.5	59.6	
5.5		60.5
10.5	69.2	
15.5	77.3	
20.5	78.7	
25.5	82.3	
30.5	83.7	
35.5	84.2	
40.5	84.7	
45.5	84.7	
50.5	84.3	
55.5	81.1	
60.5	80.1	
65.5	73.8	
70.5	72.4	

STATION J-6

0.0	52.8	
0.5		54.3
3.5		51.1
5.5	48.5	54.2
10.5	39.6	36.2
13.5	63.4	62.0
15.5	63.0	
20.5	68.5	
25.5	69.2	74.7
30.5	74.3	
35.5	78.2	
40.5	79.1	
45.5	80.3	
50.5	81.5	81.0
55.5	81.2	
60.5	82.3	
65.5	79.7	
70.5	71.5	

TABLE 3

STATION J-7

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.0	58.5	29.3
3.5	74.3	33.7
6.5	58.0	58.0
8.5	78.1	
10.5	61.0	80.0
13.5		83.0
15.5	80.0	84.7
20.5	83.9	
25.5	84.0	85.5
30.5	85.2	
35.5	85.3	
40.5	85.4	
45.5	85.7	
50.5	85.7	
55.5	85.0	
60.5	85.5	
65.5	85.5	

STATION J-8

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.0	61.0	
0.5	61.2	
3.5	62.6	
5.5	65.4	
10.5	70.3	
15.5	72.3	
20.5	74.4	
25.5	86.6	
30.5	89.0	
45.5	89.6	
55.5	88.5	
65.5	87.9	

STATION J-9

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.5	61.8	
5.5	62.7	
10.5	65.0	
12.5	68.5	
14.5	71.9	
18.5	75.9	
22.5	78.9	
25.5	81.3	
30.5	75.7	
40.5	75.0	
50.5	76.1	
60.5	76.9	
65.5	76.9	

STATION J-10

0.5	36.9	36.9
3.5	38.4	
5.5	60.5	60.2
10.5	60.4	62.6
15.5	65.2	
20.5	66.9	66.9
25.5	68.6	
30.5	70.4	
35.5	72.8	
40.5	76.2	77.7
45.5	78.0	
50.5	79.2	
55.5	79.8	
60.5	80.2	

STATION L-1

0.5	54.9
3.5	55.1
5.5	55.1
10.5	56.6
15.5	63.8
20.5	62.5
25.5	74.8
30.5	77.1
35.5	77.9
45.5	76.5
55.5	73.1
65.5	74.5
75.5	70.6
82.5	71.4
83.5	71.8
84.5	71.8
85.5	51.5
86.5	55.7
90.5	53.6

STATION L-2

0.5	51.8
3.5	51.5
5.5	51.1
10.5	50.7
15.5	53.6
20.5	68.8
30.5	70.0
40.5	70.0
50.5	68.2
60.5	66.5
70.5	52.8
75.5	50.4
80.5	48.1

TABLE 3

STATION L-3

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.5	21.5	
5.5	22.5	
10.5	24.0	
15.5	40.0	
25.5	60.0	
27.5	73.0	
30.5	74.0	
40.5	75.0	
45.5	75.4	
55.5	76.0	
60.5	76.0	
65.5	74.2	
70.5	73.8	
75.5	65.5	
80.5	55.4	

STATION L-4

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.5	21.1	
3.5	21.1	
5.5	19.8	
7.5	20.5	
10.5	25.6	
13.5	38.8	
15.5	49.4	
18.5	53.2	
20.5	56.8	
25.5	66.5	
30.5	77.4	
35.5	79.4	
40.5	81.4	
45.5	81.0	
50.5	62.3	
52.5	65.4	
55.5	74.1	
60.5	81.5	
65.5	80.6	
70.5	49.8	
75.5	49.0	
80.5	50.0	

STATION L-5

DEPTH (m)	TRANSMITTANCE (%/m)	
	DOWN	UP
0.5	21.0	
5.5	17.0	
10.5	20.5	
12.5	13.0	
15.5	6.0	
20.5	2.0	
22.5	14.0	
25.5	1.0	
30.5	36.0	
33.5	60.0	
35.5	35.0	
40.5	74.0	
45.5	55.0	
50.5	34.0	
55.5	40.0	
58.5	20.0	
60.5	1.0	

STATION L-6

0.5	26.0
2.5	20.0
5.5	22.0
10.5	25.0
15.5	20.0
20.5	20.0
25.5	40.0
30.5	20.0
35.5	45.0
40.5	10.0
45.5	10.0
50.5	30.0
55.5	37.0
60.5	40.0

STATION L-7

0.5	18.2
3.5	18.7
5.5	19.0
8.5	19.8
10.5	20.2
13.5	40.0
15.5	63.6
18.5	63.5
25.5	62.8
30.5	71.4
35.5	39.5
40.5	33.0
50.5	32.0

STATION L-8

0.5	22.0
5.5	21.5
10.5	21.6
15.5	22.5
20.5	44.5
22.5	54.5
25.5	56.0
30.5	40.0
33.5	48.0
35.5	40.0
37.5	20.0
40.5	1.0
42.5	29.0
45.5	1.0

STATION L-9

DEPTH (m)	TRANSMITTANCE (%/m)
	DOWN
0.5	34.0
5.5	34.0
10.5	35.0
14.5	35.0
15.5	29.5
20.5	29.5
21.5	33.5
23.5	45.5
25.5	26.5
28.5	16.0

STATION M-1

DEPTH (m)	TRANSMITTANCE (%/m)
	DOWN
0.5	6.5
5.5	8.2
7.5	21.0
9.5	41.0
10.5	41.0
15.5	41.0
17.5	42.5
20.5	39.0

STATION M-2

DEPTH (m)	TRANSMITTANCE (%/m)
	DOWN
0.5	28.0
2.5	24.0
5.5	28.0
10.5	28.0
15.5	20.5
16.5	45.0
20.5	51.5
23.5	51.0
25.5	38.0
29.5	47.0
30.5	45.0

STATION M-3

0.5	44.0
5.5	45.0
10.5	42.0
15.5	51.0
18.0	61.0
20.0	50.0
23.0	42.0
25.0	39.5
27.0	37.0

STATION N-1

0.5	18.5
3.5	21.0
5.5	35.0
8.5	51.0
10.5	51.0
13.5	51.0
15.5	15.0
17.5	51.0
20.5	48.0
23.5	48.0
25.5	45.5
26.5	45.0

STATION N-2

0.5	22.1
5.5	21.5
7.5	20.5
8.5	24.0
9.5	50.0
10.5	58.0
13.5	62.5
15.5	57.0
18.5	62.5
20.5	60.0
23.5	52.0
25.5	50.5
28.5	48.0
30.5	47.5
35.5	47.0
38.5	42.0

STATION N-3

0.0	9.5
5.5	9.0
10.5	31.0
12.5	43.5
15.5	42.0
18.5	42.0
20.5	47.0
23.5	46.5
25.5	40.0
28.5	32.5
30.5	31.5
33.5	32.0
35.5	33.0
40.5	27.0

STATION N-4

0.0	20.0
5.5	21.5
8.5	32.5
10.5	28.0
15.5	43.0
20.5	53.5
23.5	54.0
25.5	46.0
30.5	42.5
35.5	37.5
40.5	35.8
45.5	29.0

STATION N-5

0.0	9.5
5.5	10.0
10.5	24.2
13.5	33.5
15.5	32.0
18.5	35.0
20.5	46.5
23.5	44.5
25.5	47.0
26.5	41.5
30.5	41.5
33.5	43.0
35.5	47.0
40.5	34.0

STATION N-6

DEPTH (m)	TRANSMITTANCE (%/m) DOWN
0.0	9.5
5.5	10.0
10.5	21.0
15.5	43.0
18.5	48.5
20.5	49.5
25.5	46.0
30.5	47.5
35.5	44.0
40.5	37.5
45.5	34.0

STATION N-7

DEPTH (m)	TRANSMITTANCE (%/m) DOWN
0.0	8.0
5.5	8.5
8.5	14.5
10.5	17.5
15.5	36.0
20.5	58.0
25.5	54.5
30.5	49.5
35.5	47.5
40.5	44.0
45.5	40.5
50.5	38.0

STATION N-8

DEPTH (m)	TRANSMITTANCE (%/m) DOWN
0.0	1.6
5.5	7.5
10.5	40.0
20.5	66.7
30.5	57.9
40.5	57.2
50.5	40.3

STATION N-9

0.0	9.5
5.5	8.0
8.5	10.5
10.5	9.0
15.5	49.0
20.5	62.5
25.5	72.5
30.5	74.5
35.5	74.5
40.5	71.0
45.5	61.5
50.5	47.0

STATION N-10

0.0	10.0
5.5	10.0
7.5	1.0
9.5	1.0
10.5	11.0
15.5	52.0
20.5	70.0
25.5	73.5
30.5	75.0
35.5	76.0
40.5	75.8
45.5	71.0
50.5	69.0
55.5	68.5
60.5	67.5
65.5	66.5
70.5	66.0
75.5	65.0
80.5	63.0
85.5	58.0
90.5	55.5
95.5	54.0
98.5	54.0

STATION N-11

0.0	9.0
4.5	9.0
8.5	18.0
9.5	11.0
10.5	15.0
11.5	69.0
15.5	78.0
20.5	79.0
25.5	77.0
30.5	76.0
35.5	75.0
40.5	75.0
45.5	76.0
50.5	76.0
55.5	76.0
60.5	74.0
65.5	74.5
70.5	73.0
75.5	73.0
80.5	72.0
85.5	71.8
90.5	72.0

STATION N-12

DEPTH (m)	TRANSMITTANCE (%/m)
	DOWN
0.0	18.5
5.5	18.5
8.5	80.0
10.5	82.0
15.5	83.0
20.5	84.0
25.5	85.0
30.5	85.0
35.5	84.5
40.5	84.5
45.5	83.0
50.5	90.0

STATION O-1

DEPTH (m)	TRANSMITTANCE (%/m)
	DOWN
0.0	65.6
5.5	66.0
10.5	67.0
15.5	70.9
20.5	79.8
25.5	86.9
35.5	83.9
45.5	84.8
60.5	86.9
70.5	86.1
80.5	86.1
90.5	85.3
100.5	84.3

STATION O-2

DEPTH (m)	TRANSMITTANCE (%/m)
	DOWN
0.0	18.0
5.5	22.5
8.5	72.0
10.5	76.5
15.5	80.5
20.5	84.0
25.5	84.5
30.5	83.5
35.5	78.0
40.5	76.0
45.5	75.5
50.5	71.5
55.5	67.0
60.5	64.0
65.5	64.0
70.5	62.0
75.5	62.0
80.5	65.0
85.5	62.0
90.5	62.0
100.5	64.0

STATION O-3

0.0	9.1
0.5	35.5
10.5	69.4
15.5	77.6
20.5	75.6
25.5	75.2
30.5	77.5
35.5	80.7
40.5	63.1

STATION P-1

0.0	32.8
5.5	33.0
8.5	33.0
10.5	44.0
15.5	67.0
18.5	60.0
20.5	65.0
22.5	70.0
25.5	70.0
30.5	71.0
34.5	69.5
35.5	63.0
40.5	60.5
45.5	51.0
50.5	46.0

STATION P-2

0.0	28.0
1.0	24.0
3.0	29.0
5.0	32.0
8.0	28.5
10.0	58.0
15.0	79.0
17.0	74.0
18.0	60.0
20.0	76.0
25.0	73.0
30.0	56.0
32.0	53.8

STATION R-1

DEPTH (m)	TRANSMITTANCE (%/m) DOWN
0.0	21.5
3.5	21.5
5.5	29.0
10.5	30.5
15.5	45.5
18.5	58.0
20.5	54.5
25.5	67.0
26.5	66.0
27.5	51.0
30.5	46.5
35.5	39.0
40.5	33.5

STATION R-2

DEPTH (m)	TRANSMITTANCE (%/m) DOWN
0.0	27.0
3.5	26.5
5.5	22.0
10.5	27.0
15.5	62.0
20.5	69.0
23.5	69.0
25.5	49.5
30.5	47.0
35.5	40.5
36.5	40.5

STATION R-3

DEPTH (m)	TRANSMITTANCE (%/m) DOWN
0.0	24.0
4.5	25.0
5.5	21.0
10.5	54.0
13.5	68.0
15.5	66.0
20.5	67.5
23.5	66.0
25.5	47.0
28.5	40.0

STATION R-4

0.0	18.5
3.5	22.0
5.5	59.0
7.5	61.0
10.5	50.5
15.5	60.0
20.5	56.0
25.5	46.0
27.5	37.5
30.5	37,5
34.0	31.0

STATION S-1

0.0	16.0
3.5	21.0
5.5	36.5
10.5	52.0
15.5	60.0
20.5	60.5
24.5	46.5

STATION S-2

0.0	12.0
5.5	12.5
9.5	7.5
10.5	16.0
15.5	41.0
18.5	18.0
20.5	57.0
23.5	53.0

TABLE 4

COULTER PARTICLE COUNT
(2 ml sample)

DATE	SAMPLE	TOTAL COUNT AT					RELATIVE PULSE HEIGHT					
TIME	DEPTH	THRESHOLD ZERO	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
					STATION D-1							
10 May 2300	0	809	432	106	96	39	27	18	16	4	10	10
	7	618	161	136	21	32	64	15	6	56	13	22
	13	1225	400	316	84	26	76	45	54	44	34	28
	18	802	490	126	40	28	28	2	8	10	6	9
	20	1027	605	171	71	40	36	20	11	13	14	11
	1.2*	1576	826	370	169	29	39	37	21	25	22	7
	.7*	1832	1131	318	171	76	29	8	21	15	9	7
	.2*	1674	931	330	131	62	50	44	45	7	17	15
					STATION D-2							
11 May 0050	1.2*	1952	1595	130	52	3	10	15	15	8	8	5
	.7*	2005	1491	267	115	58	6	29	1	4	5	6
	.2*	1897	1410	260	125	17	36	3	7	4	10	11
					STATION D-4							
11 May 0635	1.2*	1672	1258	281	58	16	19	7	4	12	5	3
	.7*	1775	1331	289	96	32	2	5	8			
	.2*	1732	1276	278	89	29	13	15	6	8	7	3

* Distance in meters above bottom

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
			STATION D-6 (2)									
12 May 0430	0	403	360	43	13	12	24	3	5	10	7	9
	5	344	235	34	29	3	4	7	2	7	7	5
	10	392	280	50	17	7	10	7	3	6	3	
	15	413	305	67	11	12	2	5				
	20	372	306	41	8	11						
	30	185	138	14	14	13						
	40	364	272	53	12	12	7					
	60	259	210	16	11	3						
	80	252	204	20	9	2	6					
			STATION D-7									
12 May 0535	0	475	406	42	12	4						
	5	311	277	19	5							
	10	278	228	22	12	5	2					
	25	270	222	23	11	4	1					
	40	583	480	70	9	7	7					
	45	572	450	73	25	3	4	6	5			
	55	472	390	37	26	4	4	5				
	70	298	234	40	18							
			STATION D-8									
12 May 0800	0	322	260	35	8	5	9					
	5	328	258	42	11	2	4					
	10	576	482	44	20	12	11					

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	15	252	188	35	8	3	3	6				
	25	790	615	100	20	12	13	8	5	6		
	30	279	214	41	4	9						
	40	212	169	17	4	8	6					
	50	325	256	29	16	6	4	5				
	65	276	210	32	12	5	5					
	75	245	168	42	4	6	7	8				
				STATION D-9								
12 May 0915	0	301	199	59	14	14						
	10	280	195	46	20	3	3	4				
	20	295	201	50	18	7	2	6				
	30	272	189	39	23	8	4					
	40	227	160	23	19	5						
	55	702	585	69	22	13	2					
	67	317	235	46	15	5	4	3				
	75	274	219	40	4	4						
				STATION D-10								
12 May 1100	0	312	220	64	5	12	3					
	5	222	157	39	7	11						
	15	111	81	18	4							
	20	126	84	26	2							
	35	130	121	3	7							
	50	243	193	30	6	3						
	70	73	67	19								
	75	113	90	9	6							

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
				STATION D-11								
12 May 1210	0	357	253	66	13	3	10	4				
	10	103	64	27	3							
	20	125	80	21	9	7						
	30	124	88	19	12							
	40	143	107	19	10							
	60	1604	1196	257	76							
	70*	36487	26345	6391	2160	560	155	184	191	90	86	24
				STATION D-13								
12 May 1530	0	322	163	85	22	11	6	12	9	7		
	5	367	178	75	16	31	13	9	1	5	8	11
	10	141	191	70	56	34	15	1	3	8	7	7
	15	227	130	65	7	6	4	6				
	20	152	93	23	13	6	6	4				
	30	197	155	15	13	3						
	45	176	130	21	16							
	50	144	111	12	11	1						
				STATION D-14								
12 May 1755	0	738	391	117	89	43	17	18	3	11	17	2
	10	482	146	96	120	21	18	15	4	4	20	7
	20	213	133	36	17	5	2	4	4			
	25	138	73	36	6	7	4	3				
	30	130	80	25	4	8	9					

* Mud plugging Nansen bottle petcock. Sample very dirty.

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	0-10	10-20	20-30	30-40	RELATIVE PULSE HEIGHT 40-50	50-60	60-70	70-80	80-90	90-100
	40	146	107	20	6	4						
	55	143	122	10	4							
	75	143	112	19	6							
STATION F-1												
12 May 1910	0	480	385	76	12							
	10	542	479	51	2	2						
	20	465	408	41	5	4						
	25	281	228	29	13							
	30	106	68	11								
	40	99	64	11	10	6						
	55	79	48	14	9							
	75	89	63	15	2							
STATION F-2												
12 May 2100	0	298	234	39	6	6	4					
	10	132	94	22	5	4						
	20	86	58	14	7							
	30	82	60	10	6							
	40	60	39	15								
	55	55	44	6								
	65	105	77	18	4							
	70	133	104	15	7							
	80	155	132	5	8	5						

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
				STATION F-3								
12 May	0	211	111	36	16	9	5	7	5	1		
2300	5	240	129	12	9	11	13	17	24	7	5	
	10	270	152	25	13	2	19	25	9	6	8	
	15	202	140	28	3	1	5	6	5	4		
	20	227	140	33	21	15	3	4	3			
	25	186	126	33	7	3	3	5				
	35	119	82	14	11	3						
	45	169	103	30	15	10	4					
	55	113	79	13	13	1						
	65	124	86	24								
				STATION G-1								
13 May	0	187	110	27	7	8	7	3	4	5		
0320	8	284	199	27	7	9	11	10	5	6		
	13	151	94	24	2	9	2	1	3			
	25	548	324	37	79	4	7	15	14	15	12	14
	35	131	80	15	6	8	7	7				
	43	164	33	14	1	2						
	50	134	99	15	5	9						
	60	108	76	16	9							
	70	90	60	17	8							
				STATION G-2								
13 May	0	224	148	30	4	7	16	2	1			
0530	10	207	119	27	2	1	16	10	2	13	4	3
	20	197	129	18	14	5	11	4	3	4		

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	25	180	123	17	14	12	1	5				
	30	139	107	7	4	6	3					
	40	161	118	24	3	6	2					
	50	139	97	17	1	12	3					
	60	113	63	26	3	7	9					
	68	102	66	14	17							
			STATION H-1									
13 May 0715	0	243	213	9	3	7	6					
	10	210	184	9	4	5						
	15	214	168	28	7	5						
	20	259	223	10	7	7	5					
	30	181	150	14	2	4	3					
	40	100	73	11	4	2	2					
	50	180	106	26	24	4	10	4				
	60	186	112	41	17	6	4					
	70	191	99	52	21	7	3					
			STATION H-2									
13 May 0915	0	789	483	188	13	50	6	21	1	2	7	7
	2	781	704	42	11	12	3					
	5	251	192	34	6	9	5					
	10	121	79	23	7	4						
	15	124	85	15	12	2						
	20	176	129	17	6							
	30*	334	257	32	21	15						
	40	112	72	16	8	9						
	50	153	94	23	16	8	6					
	60	128	79	25	5	5	9					
	70	233	155	46	11	10	6					

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT									
			0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
			STATION H-3									
13 May 1100	0	203	137	41	8	3	3					
	3	174	112	43	4	4						
	5	192	145	17	3	9	2	3				
	10	170	126	17	5	3	2	5	4			
	15	135	95	19	10	4						
	20	211	164	14	18	5	4					
	30	164	101	24	12	5	5	5	5			
	50	121	82	23	1	3	5					
	60	142	96	20	16	3						
	70	134	97	10	15	7						
			STATION H-4									
13 May 1310	0	323	223	39	27	3	4	5	6			
	3	228	187	10	3	8	7	4				
	5	219	152	45	2	2	2	1				
	15	183	126	35	3	3	3					
	25	156	128	4	2	8	7					
	35	132	95	13	15	5						
	40	166	128	19	3	3	5					
	60	93	62	18	2	4						
	70	124	95	16	9							
			STATION H-5									
13 May 1300	0	528	430	54	17	10	6	3				
	5	307	180	55	25	24	3	2				
	10	364	215	43	39	21	9	6	6	3	6	5

TABLE 4 (continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	15	931	364	249	66	40	30	51	20	15	22	20
	20	479	397	14	28	6	7	4	1			
	30	155	102	32	4	6	5					
	40	110	72	15	11	3						
	45	126	82	17	17	3						
	50	104	74	15	8							
	55	224	182	27	7							
	70	692	562	71	27	24	5					

STATION H-6

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
13 May 1625	0	861	324	269	71	57	27	20	16	17	11	10
	5	930	288	288	83	73	47	28	22	10	14	13
	10 *	1230	276	385	86	132	11	33				
	15	734	343	107	74	29	7	34	12	26	23	21
	20	644	247	162	52	28	34	24	21	12	2	2
	25	376	241	52	30	8	4	6	6	7	10	6
	35	221	164	18	25	4	3					
	45	115	72	33	6							
	50	254	207	26	5	6	1					

* ran out of sample

STATION H-7

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
13 May 1810	0	972	358	196	119	48	28	23	34	35	22	30
	5	1332	547	399	134	76	20	65	23	28	24	11
	10	1169	365	365	102	70	10	63	18	7	48	26
	15	970	359	258	94	24	61	19	19	12	6	50
	25	604	278	124	70	10	23	21	14	14	7	4
	30	332	228	47	17	15	3	4	2			
	40	326	244	21	16	17	1	4	9			

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT									
			0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
					STATION H-8							
13 May 1900	0	1491	550	412	142	83	66	20	44	10	25	37
	5	1414	419	428	155	49	84	41	31	29	38	45
	10	1042	342	206	102	41	69	3	24	34	19	23
	15	896	302	270	114	15	23	38	29	14	13	8
	20	559	301	124	18	10	16	28	1	9	9	15
	25	468	289	80	10	23	2	8	8	14	5	7
	30	608	407	103	8	12	31	11	16	5	7	
					STATION I-1							
13 May 2015	0	1088	515	233	68	43	44	30	9	51	16	9
	5	1140	448	58	226	114	16	44	27	31	41	31
	10	586	257	126	21	33	30	9	8	14	29	9
	15	512	223	103	40	31	30	2	2	1	9	
	20	658	526	115	64	20	29	14	22	2	1	
	25	1132	680	242	55	26	30	16	15	11	19	2
	30	852	586	140	58	7	9	14	8	3	12	7
					STATION I-2							
13 May 2120	0	1063	458	262	80	51	35	31	11	16	14	10
	3	997	435	190	84	88	41	11	9	25	21	22
	5	962	482	168	43	50	44	42	30	3	2	
	9	483	214	108	21	44	10	7	9	14	15	3
	12	440	253	65	38	23	7	5	11	11	8	4
	17	545	342	95	21	13	12	11	12	12	4	7
	23	471	257	83	40	24	15	1	3	14	6	10

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT									
			0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
					STATION J-1							
13 May 2245	0	954	444	230	71	46	26	16	27	17	13	12
	3	755	362	128	90	20	54	6	10	22	18	23
	5	614	350	95	32	29	14	18	18	13	4	11
	12	396	192	97	12	17	14	16	10	9	14	4
	17	398	244	46	22	21	23	3	15	5	9	
	22	581	447	49	10	13	18	9	11	6	7	
					STATION J-2							
13 May 2340	0	1278	598	269	56	100	69	11	14	26	47	28
	5	1190	461	269	74	85	36	52	5	40	63	1
	10	986	375	199	62	103	11	48	13	27	70	9
	14	830	338	218	32	75	15	23	14	13	33	15
	22	380	175	64	46	14	19	1				
	30	316	246	15	16	15	1					
	35	369	284	53	11	1						
	40	250	193	34	4	1						
					STATION J-3							
14 May 0120	0	1266	587	340	126	16	30	21	31	5	38	2
	10	1329	645	302	118	16	31	30	32	44	5	0
	15	1143	557	214	80	24	50	28	8	58	20	24
	20	643	360	78	50	33	27	10	21	5	18	11
	30	327	185	72	1	6						
	40	215	146	24	18	4						
	45	125	63	35	5							
	50	133	84	14	16							
	60	368	110	54	64	10	5					

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT									
			0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
			STATION J-4									
14 May 0225	0	913	551	200	31	19	15	18	17	5	12	12
	5	735	422	140	12	21	20	35	20	10	13	12
	15	863	411	71	165	61	21	13	21	19	1	6
	25	180	107	22	24	2	3					
	35	100	62	18	8	2						
	45	118	85	15	4	2						
	55	113	74	20	3	2						
	65	212	146	44	4							
			STATION J-5									
14 May 0335	0	2106	1868	158	32	8						
	5	1448	1352	44	22	5						
	15	1655	1455	77	31	34	0					
	25	1484	1427	30	7	2	2					
	35	1796	1765	9	6	5						
	50	1978	1951	21	1							
	70	1600	1576	18	2							
			STATION J-6									
14 May 0510	0	3256	3215	12	9							
	5	3646	3613	14	1							
	10	2836	2781	28	7	1						
	15	2791	2634	3	89	26	14	2	3			
	30	1648	1596	30	2	3						
	50	1477	1452	12	10							
	65	1010	977	17	2							
	70	957	935	6	1							

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
			STATION J-7									
14 May 0700	0	2987	2437	163	136	10	41	28	16	18	22	16
	3	1656	1074	257	15	89	11	60	38	22	12	13
	5	1519	1075	127	54	83	2	47	30	20	11	5
	10	1504	1232	112	32	37	20	8	6	14		
	15	1253	1188	15	19	6	5					
	40	650	622	7	7							
	65	800	783	1	1							
			STATION J-8									
14 May 0830	0	251	188	25	18							
	5	244	64	59	10							
	10	244	157	23	4	19	11					
	20	92	50	17	9							
	30	128	85	25	8							
	45	82	46	20	5							
	65	78	50	7								
			STATION J-9									
14 May	0	1226	1193	26								
	5	1144	1117	7	10							
	20	1601	1577	14								
	25	501	476	2								
	30	444	433	5								
	40	756	730	10	8							
	60	266	253	3								

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
				STATION J-10								
14 May 1105	0	216	136	44	11	6	2	4	4			
	3	65	37	19								
	5	58	40	8								
	15	89	53	21	8							
	25	143	120	5	5	4						
	40	65	48	6	2							
	60	37	27	3								
				STATION L-1								
15 May 1010	0	566	299	87	72	29	15	4	13	6	5	2
	5	688	363	157	51	28	30	5	16	13	2	11
	15	1268	758	250	51	17	53	13	14	23	21	18
	20	1037	634	175	57	17	16	54	8	32	1	4
	30	433	145	41	170	28	14	8	8	7		
	55	343	243	44	14	4	7	1	3	7	8	
	65	252	168	39	23	2	9	2				
	82	623	245	304	31	32	20	1				
	90	1017	750	134	51	16	7	9	6	5		
				STATION L-2								
15 May 1130	0	834	469	146	64	16	43	21	18	15	16	8
	10	632	265	192	41	50	24	6	6	4	9	9
	15	485	318	81	14	29	13	5	4	3	1	2
	20	319	206	29	28	15	6	9	4	7	4	1
	40	234	180	31	4	14						
	60	160	101	36	13							
	70	159	114	28	9							
	80	445	347	54	15	11	8					

TABLE 4 (Continued)

DATE	SAMPLE	TOTAL COUNT AT	RELATIVE PULSE HEIGHT									
TIME	DEPTH	THRESHOLD ZERO	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
					STATION L-3							
15 May 1230	0	1592	752	240	165	82	68	61	9	62	25	11
	6	1803	774	410	168	66	81	58	8	14	52	14
	15	1371	497	341	110	50	71	13	42	57	28	11
	25	1137	467	268	54	85	64	38	23	9	14	16
	40	540	130	178	48	14	11	9	32	56	2	6
	55	207	110	30	30	7	11	2	8			
	80	594	413	122	29	10	6	5				
					STATION L-4							
15 May 1420	0	936	442	217	90	29	46	26	14	24	5	6
	5	858	294	225	109	88	21	27	18	15	11	4
	10	939	375	253	81	76	21	22	4	23	8	7
	15	224	155	41	7	3	7	6				
	30	520	388	48	6	18	19	10	4	5	7	4
	40	1046	441	271	80	59	53	18	13	24	6	4
	50	163	117	11	14	10	3					
	60	901	634	150	47	28	14	6	3			
	70	532	351	57	78	13	8	5	7	6		
					STATION L-5							
15 May 1540	0	621	302	158	68	4	19	11	24	11	2	3
	5	461	205	104	58	4	30	8	4	5	2	1
	15	433	277	63	28	19	9	5	5	8	10	9
	30	123	72	16	16	2	5	3				
	40	60	45	3	3							

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT									
			0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	45	111	74	17	12							
	55	92	49	19	12	5						
	60	330	254	50	7	7	5					
				STATION L-6								
15 May 1750	0	1001	406	240	126	79	22	29	18	19	9	6
	5	806	394	210	191	17	19	6	5	4	12	13
	10	1085	500	132	120	43	59	79	14	27	17	5
	15	305	265	66	23	12	8	5	5	2	8	1
	30	323	248	26	8	7	11	8	5			
	45	176	100	37	8	3	8	7	4			
	60	1026	728	196	41	10	9	12	12	8		
				STATION L-7								
15 May 1900	0	1711	789	426	152	76	59	21	20	40	18	18
	5	1408	588	358	76	104	64	41	17	36	13	9
	10	1295	570	345	136	48	31	33	44	18	6	12
	15	1363	526	369	144	113	9	8	32	46	27	2
	40	182	105	11	13	7	5	24	7			
				STATION L-8								
15 May 1950	0	1392	659	349	40	142	14	14	58	30	16	4
	5	1380	566	369	100	101	29	15	37	34	31	12
	10	1545	705	345	111	88	23	47	56	24	25	21
	15	1453	612	446	63	86	20	15	30	12	38	19

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	20	1316	552	296	138	72	28	35	24	40	16	20
	25	748	354	142	88	42	10	23	18	4	14	5
	30	550	284	120	26	32	14	8	8	7	4	6
	35*	418	199									
STATION L-9												
15 May 2050	0	1237	564	294	143	60	21	9	13	15	13	17
	5	1103	482	327	91	57	18	14	6	16	21	14
	10	1299	698	267	91	65	37	36	4	2	16	19
	15	960	434	230	53	55	25	35	18	15	13	14
	20	1108	450	292	142	43	27	28	12	5	8	23
	25	1073	456	251	129	40	48	12	27	14	25	9
STATION M-1												
15 May 2210	0	1779	851	370	119	43	71	33	34	41	23	32
	3	1802	723	416	164	134	17	43	34	32	38	21
	6	1829	774	373	170	130	25	44	40	26	26	28
	10	1605	626	352	153	90	108	20	22	17	6	16
STATION M-2												
15 May 2325	0	836	369	243	23	45	31	7	18	24	12	5
	5	1188	502	322	102	72	22	20	24	30	9	11
	10	1222	526	280	126	88	7	45	20	31	10	4
	15	1525	781	311	136	94	8	21	55	24	14	2
	20	1266	679	218	68	72	26	19	45	26	13	6
	25	1235	709	207	90	37	38	32	18	15	11	28

* ran out of sample

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
				STATION M-3								
16 May 0100	0	1406	790	238	122	63	42	28	7	20	16	2
	3	856	269	250	97	54	33	10	35	25	11	8
	6	920	394	175	115	64	27	28	27	18	1	3
	12	723	282	146	86	29	44	24	23	4	8	4
	21	626	259	156	35	66	15	18	14	18	2	5
	26	630	378	92	62	15	19	16	13	5	1	2
				STATION N-1								
16 May 0255	0	2388	1223	622	270	74	50	56	32	14	7	8
	5	2551	1337	619	200	112	117	39	34	14	8	6
	7	2923	1292	886	247	147	86	94	37	17	43	3
	10	1888	835	509	290	109	50	24	44	30	31	5
	17	488	205	122	63	21	8	9	9	6	12	4
	23	444	180	119	53	34	9	20	3	1	3	2
	25	594	280	154	32	40	19	29	3	5	3	3
				STATION N-2								
16 May 0530	0	3020	1774	694	253	53	119	37	21	27	11	10
	10	532	257	154	40	20	10	11	6	3	9	4
	15	1330	895	233	60	29	34	9	7	12	10	11
	20	938	554	208	35	71	18	12	3	6	1	5
	25	1027	650	206	52	47	31	8	4	8	2	7
	35	961	649	160	8	80	19	8	14	4	1	2

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
					STATION N-3							
16 May 0645	0	2832	1614	731	241	50	59	57	16	11	11	4
	5	3195	1854	698	322	117	23	6	69	43	22	15
	10	1518	817	337	97	74	57	17	23	22	14	7
	20	779	396	202	52	41	8	18	8	20	9	5
	25	115	376	160	54	31	17	21	7	19	2	4
	35	882	524	190	54	27	22	15	9	15	5	5
					STATION N-4							
16 May 0740	0	4415	2119	1309	482	146	77	50	47	13	24	4
	5	5330	3403	999	412	256	67	51	31	49	11	10
	10	3928	2228	836	417	207	55	42	34	15	32	4
	20	1063	541	249	77	78	56	14	13	5	6	8
	30	957	423	272	110	79	4	24	18	8	5	7
	40	1788	900	381	260	120	8	23	15	5	16	11
	45	1792	984	307	212	57	111	50	10	16	17	13
					STATION N-5							
16 May 0835	0	4198	1876	1147	489	225	154	111	41	52	21	15
	5	5368	2753	1421	609	207	141	52	12	69	20	7
	15	1484	297	352	232	200	133	87	70	5	32	26
	25	1004	520	207	90	81	28	19	22	8	4	4
	40	1046	506	247	123	49	44	8	31	6	8	5

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
					STATION N-6							
16 May 0910	0	5688	2519	943	1624	158	112	58	47	51	11	9
	5	4656	2037	1298	596	325	136	93	29	14	23	35
	15	2898	1702	533	215	99	112	71	47	19	22	24
	20	1090	471	299	129	92	27	4	14	7	13	14
	30	851	414	178	81	74	26	15	14	23	7	
	40	1380	829	268	98	60	55	5	38	6	5	4
					STATION N-7							
16 May 1010	0	4158	1563	1056	488	435	217	110	53	52	46	49
	5	4308	1851	1231	228	430	270	89	58	25	32	38
	10	2124	999	540	243	113	89	59	10	10	13	11
	20	2376	1309	516	281	88	41	47	40	6	15	4
	30	888	417	224	105	62	24	11	7	16	4	5
	40	545	268	135	44	43	15	8	1	4	8	9
					STATION N-8							
16 May 1200	0	5305	2065	1796	659	381	155	88	35	26	29	17
	5	7663	4485	1487	701	260	277	85	78	88	24	56
	10	3091	1430	814	285	195	96	84	50	11	30	28
	20	796	432	179	76	50	5	5	7	11	5	5
	35	492	316	97	28	7	11	13	4	7		
	50	1210	906	270	61	33	18	6	4	6		

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
				STATION N-9								
16 May 1335	0	2069	621	358	173	232	79	121	96	68	86	84
	5	3267	1324	757	491	182	104	132	32	37	28	26
	15	4132	2075	1101	472	144	122	57	45	10	40	23
	20	1391	722	360	112	58	51	36	11	9	3	3
	30	777	484	134	73	23	15	11	7	12	9	
	40	368	259	55	13	17	5	2	6			
	50	362	230	63	27	14	13	7				
				STATION N-10								
16 May 1710	0	4643	1728	1322	593	253	305	157	20	50	60	34
	5	5275	1655	1844	691	402	174	168	74	36	55	19
	7	5175	1872	1730	662	250	180	191	19	57	54	45
	10	3602	1293	597	277	194	78	57	55	46	17	23
	30	793	524	168	40	18	10	4	8	6		
	50	269	182	42	16	8	4	4				
	90	310	204	69	14	6	6	3				
				STATION N-11								
16 May 1710	0	4052	1277	1397	592	293	193	54	99	80	41	17
	5	7518	5054	1319	402	279	106	95	65	70	9	14
	10	4648	1660	1538	597	341	75	157	32	70	47	11
	15	1243	774	180	114	75	17	6	11	11	3	7
	50	360	233	59	30	8	6	3	1	4	5	1
	90	345	223	46	28	34	3	4	3	5		

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	0-10	10-20	20-30	30-40	RELATIVE PULSE HEIGHT 40-50	50-60	60-70	70-80	80-90	90-100
				STATION N-12								
16 May 1830	0	3498	1248	1094	437	235	132	90	85	27	8	69
	5	3629	1437	1323	290	246	39	91	56	26	23	11
	10	2606	670	902	401	155	142	62	76	23	65	40
	20	888	155	315	273	59	61	35	12	17	14	13
	45	224	184	49	16	15	8					
	55	113	65	27	7	3						
	80	302	220	32	16	19	7					
				STATION N-13								
16 May 2000	0	2236	841	762	240	127	18	100	29	20	34	23
	5	2085	736	700	242	130	58	67	31	40	31	26
	10	1816	232	756	322	275	11	56	25	62	18	16
	15	1790	646	153	576	159	76	15	17	33	30	43
	20	644	231	151	103	64	24	20	15	8	12	8
	50	396	316	43	9	9	6	7				
	90	333	145	133	18	14	11	4				
				STATION O-1								
17 May 0155	0	772	588	115	14	16	14	3	5	2	5	
	5	336	266	35	10	7	5	1	6			
	10	267	191	38	7	2	4	4	1	1		
	15	211	145	37	2	12	1					
	25	872	548	120	105	41	6	7	6	5	9	2
	55	482	304	118	27	5	6	5	2	3	2	
	80	292	242	15	12	7						

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
					STATION O-2							
17 May 0400	0	3338	1778	818	246	136	61	69	46	30	25	23
	3	4054	1860	1097	497	139	28	61	114	43	57	40
	5	4603	2069	1342	484	270	94	105	45	42	34	31
	9	3665	1781	824	384	209	123	83	72	25	16	25
	30	195	102	40	10	12	33	3	5	6	2	3
	70	172	125	23	9	3	3					
	100	362	258	63	21	4	4	4				
					STATION O-3							
17 May 0605	0	2603	1363	673	140	154	64	57	31	32	21	21
	5	2815	1352	753	354	87	87	47	47	13	7	31
	13	462	203	101	46	59	27	1	3	3	4	
	25	150	99	27	4	8	1					
	35	152	101	2	24	10	1					
	40	177	93	32	26	10	2	3				
					STATION P-1							
17 May 0800	0	2989	1268	864	416	163	69	34	35	31	27	27
	10	2521	1180	770	246	135	36	29	41	16	22	14
	15	1785	830	560	126	67	87	13	31	10	13	6
	25	880	459	207	82	128	31	17	17	12	11	4
	40	789	316	186	92	84	40	16	9	4	7	10
	50	1775	862	240	171	159	132	77	40	15	15	28

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
		STATION P-2										
17 May 0910	5	2643	1438	525	211	188	70	36	28	41	31	6
	10*	3116	1208	1240	207							
	15	741	366	174	87	10	30	12	25	7	8	8
	20	473	215	114	38	20	21	22	8	13	4	3
	30	851	503	149	61	55	9	16	25	12	5	4
		*ran out of sample										
		STATION R-1										
17 May 1230	0	1936	1036	228	164	58	98	31	7	58	95	38
	10	2181	1042	322	166	176	52	90	49	35	83	46
	15	1667	210	352	395	249	51	110	130	68	5	15
	20	1688	174	643	110	218	200	98	34	14	7	71
	25	1489	661	362	187	95	55	29	29	18	18	9
	30	930	691	113	41	22	6	19	11	7	5	12
	40	1782	1279	203	92	58	32	26	19	16	11	17
		STATION R-2										
17 May 1445	0	1908	1166	241	191	107	86	54	9	11	3	12
	5	1390	392	390	264	111	41	86	30	42	9	15
	10	686	344	113	107	53	15	17	1	15	1	13
	20	411	288	35	6	38	5	12	3	1	2	1
	30	890	607	188	18	17	26	20	0	2	1	6

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO	RELATIVE PULSE HEIGHT									
			0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
STATION R-3												
17 May 1600	0	945	384	359	81	52	10	12	7	11	9	2
	5	1283	750	264	117	53	26	14	25	3	5	5
	10	1063	689	126	126	30	34	17	9	3	2	9
	15	1511	1026	236	41	98	13	24	20	5	9	9
	20	958	568	176	70	43	26	9	21	18	2	3
	28	2179	1531	261	152	95	29	10	42	11	14	6
STATION R-4												
17 May 2255	0	1917	1061	298	154	118	76	42	35	23	21	25
	5	1725	857	288	179	146	22	28	69	50	8	9
	10	978	563	194	71	35	33	24	4	25	8	1
	15	1146	703	246	72	31	13	35	6	6	8	10
	25	1494	1102	179	70	49	32	9	7	14	2	6
	35	1332	847	260	107	16	14	29	14	13	8	7
STATION S-1												
17 May 0000	0	2877	1287	564	312	150	131	130	51	64	17	23
	5	2716	1307	452	275	182	85	119	55	65	16	29
	10	2087	1011	361	167	148	124	85	2	27	36	31
	15	1452	679	226	190	131	37	26	5	46	40	34
	25	1318	777	188	133	23	52	7	49	19	4	

TABLE 4 (Continued)

DATE TIME	SAMPLE DEPTH	TOTAL COUNT AT THRESHOLD ZERO					RELATIVE PULSE HEIGHT					
			0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
				STATION S-2								
18 May 0055	0	4392	2462	981	478	151	113	84	9	45	4	9
	10	3726	1817	990	356	232	156	40	6	54	4	3
	15	4675	3287	774	320	98	61	26	27	3	23	21
	20	3155	1690	866	254	104	60	59	23	4	23	16
	25	1509	965	232	121	58	34	16	14	22	11	13

TABLE 5

SALINITY DATA

STATION D-10

DEPTH (m)	SALINITY (°/oo)
0	33.645
5	33.682
15	33.705
20	33.805
35	33.839
50	33.870
70	33.877
75	33.898

STATION D-13

0	33.556
5	33.657
10	33.685
15	33.732
20	33.741
30	33.765
45	33.793
50	33.804

STATION F-1

0	33.605
10	33.618
15	33.638
20	33.641
30	33.672
40	33.768
60	33.845
70	33.859

STATION N-7

10	33.657
16	33.753
20	33.880
30	33.880

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13. ABSTRACT

A detailed oceanographic survey of the coastal waters between Monterey Bay and San Francisco Bay, California, was conducted from 10 through 18 May 1969. Measurements of beam transmittance, sound velocity, temperature, and particulate count were obtained. Over 500 water samples were taken for particulate analysis.

The optical properties of this region were found to be very complex. The waters appeared to be affected by flow from San Francisco Bay, littoral material, upwelling, and possibly sewage outfalls during the survey. A greater volume of water with low transmissivity and high particle count existed in the northern region of the survey area than in the southern region. An eddy system between Monterey Bay and Point Ano Nuevo was suggested.

Approximately 90 percent of the particles affecting beam transmittance were less than 12 μ in diameter. Particle sizes were found to decrease with increased depths. A fairly good correlation of beam transmittance with particle count was observed except in near shore areas.

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Beam Transmittance						
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San Francisco Bay, California						
Sewage outfalls						
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